APRIL

PROPERTY OF
DENTAL LIBRARY
UNIVERSITY OF MICHIGAN
DON'T MUTILATE OR REMOVE

THE JOURNAL OF THE NATIONAL DENTAL ASSOCIATION

1922

Soft Fiber of Tomes—*Bodecker*

Preservation Versus Restoration—*Gillis*

Michigan Research Report—*Rickert, Lyons*

Diet in Relation to Health—*McCollum*

Contractions and Expansions of Amalgams —*Gray*

Action of Medicaments Upon Teeth of Dogs—*McConnell, Grace, Lang*

Tooth Decay Among School Children —*Hollister*

Harelip and Cleft Palate—*Federspiel*

Dental Ethics—*Editorial*

NATIONAL DENTAL ASSOCIATION MDCCCXCVII

TWENTY-FIVE CENTS

CONTENTS

Nevada State Dental Association ..... Frontispiece

ORIGINAL COMMUNICATIONS

The Soft Fiber of Tomes, a Tubular Structure: Its Relation to Dental Caries and the Desensitization of Dentin.
By C. F. Bodecker, D.D.S. 281

Preservation versus Restoration.
By Robert R. Gillis, D.D.S. 295

Report of Research Committee. Financed by the Michigan State Dental Society.
By U. G. Rickert, D.D.S., and Chalmers J. Lyons, D.D.S. 300

Studies of Diet in Relation to Health.
By E. V. McCollum, Ph.D. 310

Contractions and Expansions of Amalgams with Time.
By Arthur W. Gray, Ph.D. 324

The Action of Medicaments upon the Supporting Tissues of the Teeth of Dogs.
By Guthrie McConnell, M.D., Linwood G. Grace, D.D.S., and Alphonse Lang, B.B. 328

Pennsylvania's Method of Solving the Problem of Tooth Decay among School Children.
By C. J. Hollister, D.D.S. 337

Harelip and Cleft Palate.
By M. N. Federspiel, B.S., D.D.S., M.D., F.A.C.D. 341

Reminiscences of Forty-five Years in Dentistry.
By C. N. Johnson, M.A., L.D.S., D.D.S., M.D.S., F.A.C.D. 354

EDITORIAL DEPARTMENT

Dental Ethics 358
The Earliest Man and the Latest Disease 360
A Letter to Our Advertisers 361

ANNOUNCEMENTS

Calendar of Meetings (National, State, Examining Boards, Study Clubs and Other Societies).—Indiana State Dental Association.—Illinois State Dental Society.—Virginia State Dental Association.—South Dakota State Dental Society.—South Carolina State Dental Society.—Massachusetts Dental Society.—Southwestern Dental Society.—Arkansas State Board of Dental Examiners.—Board of Dental Examiners of California.—Colorado State Board of Dental Examiners.—Alabama Board of Dental Examiners.—Iowa State Dental Board.—Florida State Board of Dental Examiners.—Maryland Board of Dental Examiners.—North Carolina State Board of Dental Examiners.—Pennsylvania State Board of Dental Examiners.—Virginia State Board of Dental Examiners.—West Virginia State Board of Dental Examiners.—The Connecticut Dental Commission.—Michigan Dental Examinations.—New Jersey Board of Registration.—National Alumni Association of the Baltimore College of Dental Surgery.—American Dental Library and Museum Association.—National Dental Sorority.—The Pacific Coast Society of Orthodontists.—Psi Omega Fraternity.—Xi Psi Phi Fraternity.—Dental Hygienist Association of the State of New York.—The American Society of Dental Radiographers.—Organization of the Nevada State Dental Association.—Transportation Arrangements for Los Angeles Meeting.—Dental Corps Orders from War Department 362-370

ADVERTISING DEPARTMENT

Index to Guaranteed Advertisements A-67
Classified Section A-62, A-63

NEVADA STATE DENTAL ASSOCIATION

Organized January 14, 1922, at Reno, by thirty-seven charter members. Governor Boyle, (→) was the guest of honor. This is the last state to affiliate with the National Dental Association

THE JOURNAL
OF THE
National Dental Association
VOL. 9 APRIL, 1922 NO. 4

Original Communications

THE SOFT FIBER OF TOMES, A TUBULAR STRUCTURE: ITS RELATION TO DENTAL CARIES AND THE DESENSITIZATION OF DENTIN[1]

By C. F. BODECKER, D.D.S., Berlin, Germany

(Read before the National Dental Association, Milwaukee, Wisconsin, August 15-19, 1921)

THE study of the histological character of the dentin has engaged the interest of the microscopist for over eighty years, and even in this long span of time the opinions do not agree as to some of its most important structures. Before I pass on to a short exposition of the views of the different authors, I wish to emphasize the fact that an exact knowledge of the minute histological structure of the dentin is absolutely necessary to comprehend certain phases of the phenomena of decay, as well as to understand the action of pressure anesthesia on this tissue. A great amount of work has been done on this subject, especially during the last twenty years; and the designations of the sheaths and zones have often been used differently by the several authors, causing great confusion. It is therefore necessary to cite the views held by the principal histologists for the proper understanding of this matter.

I would not have the assurance to urge my observations upon the profession in face of all the illustrious men who have worked on this subject, were it not for the fact, that my conclusions were drawn from specimens treated by special histological methods and by the

[1]C. F. Bodecker, "Some Recent Investigations upon the Histology of the Dentin," *Dental Review*, XXVI (1912), 260.

use of the ultra-violet light. The description of the latter I published at length, in the *Dental Review* of 1906. In this paper I only wish to say, that by means of this short-waved light, unstained specimens can be photographed, thus obviating misinterpretations due to staining.

The history of the research work on the dentin, is remarkable in several respects. The results of the investigations conducted in the time from 1835 until 1863 were considered final for a period of about thirty-five years. In 1899 a new period of investigations set in, which brought out a number of inconsistencies in the old investigations, and opened the way to a more satisfactory interpretation of the structures on the dentin from a physiological standpoint. The first thoro examinations of dentin were conducted by Purkinje in 1835 and Retzius in 1837. It was, however, the excellent work of Koelliker, John Tomes, and Neumann that brought results of lasting value.

Koelliker in 1852, showed the possibilities of isolating tubules from the dentin by treatment with strong mineral acids or alkalies. He described these structures as tubes, filled with fluid lying in unobstructed tunnels in the basis substance of the dentin. These structures are known to you as Neumann's sheath.

In 1856, four years later, John Tomes isolated structures from the dentin, which he termed fibers, by mechanical means, and described them as originating from the odontoblastic layer of the pulp. Koelliker then identified the structures he had observed, with the fibers of Tomes, believing that he had deceived himself in regard to their tube-like appearance. Koelliker erroneously confirmed the view of Tomes.

Neumann, in 1863, then proved that two separate structures existed, that is, the tubes isolated by Koelliker and the fibers described by Tomes. Thereupon the tube inclosing the soft fiber of Tomes was named Neumann's sheath, which name it still preserves.

After Neumann's publication, the controversy seemed settled, till Roemer in 1899, again claimed that the structures seen by Koelliker and Tomes were identical. He returned to Koelliker's original conception, that the dentin is composed of a basis substance, permeated by an infinite number of tubes arising from the odontoblasts. In the descriptive text of a beautiful atlas of photomicrographs, published in 1909, Roemer again expresses the same view. For the present, I wish you to keep in mind only the controversy: Is Tomes's fiber a solid or a tubular structure? Later, in the photomicrographs, I will show other structures which are still subjects of discussion.

Influenced by the work of Roemer, I began my own investigations of the dentin in 1911, and was soon led to the conclusion that the so-called Tomes's fiber, that is, the prolongation of the odontoblast, is not a solid fiber, but a tube.

Before, however, continuing with the description of the more modern researches, I wish to consider the functional efficiency of a system of tubules in the dentin, viewed from a physiological standpoint, as opposed to a system of fibers.

The dentin, as we all know, has both sensation and nutrition, and up to some years ago Tomes's fiber was supposed to serve both these functions. Now, however, we can safely believe that nerves are responsible for the sensation; for they have been demonstrated by Mummery and others in the basis substance of the dentin. It was neither histologically nor physiologically correct to ascribe sensory function to Tomes's

fiber, as this is a prolongation of the odontoblast, a cell having metabolic function. Metabolism, according to Gould, the phenomena whereby organs transform substances into complex tissue elements, undoubtedly takes place in the dentin. We note that with age the canals become smaller in diameter, proving that a deposition of calcium salts has occurred. Nutrition in the dentin is analagous to the nutrition of a muscle. In both cases a circulatory system is necessary to carry products to the tissue for metabolism. Regarded from a logical point of view, we are forced to the conclusion that a system of tubes is more efficient than a system of fibers. The fact that such a system of tubes does exist is proved by my photomicrographs. These tubes are direct prolongations of the odontoblasts and carry the nutrient fluid from the pulp to the basis substance of the dentin.

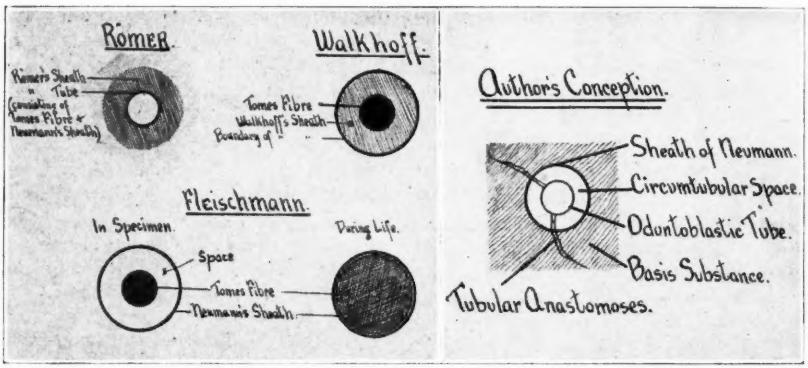
John Tomes, in speaking of the dentinal fibers says: "When stretched to a considerable extent, their diameter becomes diminished, and they finally break, a sort of bead sometimes appearing at the broken end. This would seem to indicate that its external portions are in some degree firmer than its axial portion." We see, therefore, from this quotation, that Tomes considered the fiber to be of unequal consistency. A proof of the presence of fluid, in normal dentin, is that tiny globules form on the surface of a fresh fracture. The exact chemical composition of this dentinal fluid is unknown; to my mind, it is a serous fluid containing calcium salts and albumen. This latter ingredient causes the fluid contents of the odontoblastic tube to coagulate under the influence of fixing agents, thus giving the impression of a solid fiber under the microscope. My specimens of decalcified dentin convinced me of the probability of Tomes's fiber being a tubular structure, although it was only possible to find this tubular appearance at a few places. At all other parts of the section, Tomes's fiber appeared as a disk, that is, a solid fiber in cross-section. I, therefore, came to the conclusion that if my theory were correct that this structure only appeared solid by its contents being coagulated thru the fixing agent, it ought to be possible to empty these tubes before fixing and preparing the slide and thus obtain a more uniform picture, showing the tubular nature of the odontoblastic process. Two methods were used to accomplish this; one was masceration of the dentin, allowing the entire contents of the tubes to putrefy, the other, which gave by far the better results, was the use of pyridine in vacuum.[2] Photomicrographs of human dentin treated by the latter method are given, in which the odontoblastic processes, at most all places, appear as rings and not as disks. Needless to say, none of the photomicrographs have been retouched. A possible criticism of the use of this method of treating dentin for microscopical examination, would be that thru this treatment the entire fiber of Tomes had been destroyed, and that the remaining tube is the more resistant sheath of Neumann. The illustrations, however, show *two* concentric rings within the lumen of the dentinal canal.

The diameter of the dentinal canals in human teeth is exceedingly small, varying from 1 to 3 microns, so that

[2]Pyridine is a coal-tar derivative, strongly alkaline, with chemical properties similar to ammonia, and a good solvent of fats. Fresh dentin was cracked into small pieces and placed in this chemical for twenty-four hours under a partial vacuum; the pressure gradually rising in this time from 10 to 760 mm. of mercury. Such remarkably high vacuum can be obtained only by using a motor driven oil vacuum pump. The specimens were then placed in formalin, decalcified, and sectioned on the freezing microtome in the usual manner.

only by using the highest magnifications can the details of their contents be distinguished. For this reason, I examined a number of other species of dentin, and found the dentinal canals of sheep's teeth to be much larger. In such specimens the difficulty of examination is lessened and we readily recognize the same arrangement of Neumann's sheath and the tubular process of the odontoblast.

Figure 1 is a diagram of Kantorowicz of Neumann's sheath, as seen in the right schematic drawing. Walkhoff's view is shown above, to the right. Tomes's fiber is represented as a disk, surrounded by a broad area corresponding to Fleischmann's space, but which Walkhoff claims to be a differentiated basis substance. External to this is the sheath of Neumann, which Walkhoff calls the boundary to his sheath. Roemer advances a theory older than Walkhoff's, which is still different, and it



1 2

Figs. 1 and 2.—Fig. 1, schematic cross-section of the minute structures of the dentin according to the theories of different authors (Kantorowicz). Fleischmann's view is the most prevalent. Fig. 2, the author's conception of the minute structures of the dentin.

explaining the theories of the different authors.

The two lower diagrams represent Fleischmann's view, which most nearly corresponds to the interpretation generally accepted of Tomes's fiber and Neumann's sheath. The left diagram depicts the condition as seen in a microscopical specimen in cross-section, and shows a space between the fiber and Neumann's sheath. Fleischmann claims the production of this space to be due to shrinkage of the fiber, and therefore believes, that during life Tomes's fiber fills out the entire lumen

was thru his work that I was led into the research of dentin. He claims that Neumann's sheath and Tomes's fiber are one and the same structures, and that Neumann's sheath, as drawn and described by all other authors, does not exist. External to the odontoblastic process, Roemer shows an area corresponding in position to Walkhoff's sheath and Fleischmann's space, which he claims to be a differentiated basis substance.

My interpretation of microscopical specimens of dentin, as seen in cross-section, is depicted in Figure 2. The

outer ring represents Neumann's sheath. Inclosed within this sheath we see another ring, the prolongation of the odontoblast, that is, Tomes's fiber is, to my mind, not solid, but in the form of a tube. In my first specimens only one ring was stained and at that time I thought that it was Neumann's sheath, shrunken from the walls of the basis substance. Later, however, by using Delafield or Ehrlich hematoxylin, I was able to obtain cross-sections of dentin, showing two concentric rings as well as "solid fibers." Such fibers are nothing more or less than the uniformly stained tubular wall with its coagulated contents. If critics claim that the soft fiber of Tomes has fallen out of the central space, they must offer an explanation for the existence of the sheath around the fiber, as in the photomicrographs *two* rings are shown, one within the other, Neumann's sheath and the tubular process of the odontoblast.

If we admit that Tomes's fiber is not solid, but a tube, the name of "fiber" becomes inapt. As it is a prolongation of the odontoblastic cell, I would suggest the name of *odontoblastic tube* or *tubular process of the odontoblasts* for this structure. Its origin and form are thus minutely described.

The walls of the odontoblastic tube seem to be elastic, and are a direct continuation of the walls of the odontoblast, while the contents of the tube are probably furnished by the cells itself. At frequent intervals very fine projections run from the outer surface of the tube, thru Neumann's sheath into the basis substance, anastomosing with similar branches of neighboring tubes. To these minute structures I have given the name of *dentinal tubular anastomoses.*

Figure 3, a drawing by Hart, is the dentin of a human temporary tooth, cross-section, stained with chloride of gold. There are two points to which I wish to call your attention in this illustration; firstly, the so-called transverse offshoots of the dentinal fibers, and secondly, the tubular appearance at some places. These structures passing from the dentinal fibers into the basis substance, were already shown in the previous schematic drawing; the proof of their existence will be furnished in some of the following photomicrographs.

Figure 4, a drawing by Heitzmann,

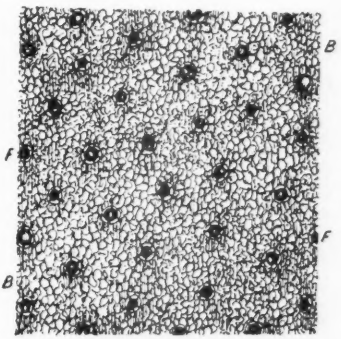


Fig. 3.—Drawing of cross-section of dentin showing dentinal fibers with vacuoles and radiating offshoots (x 1200; J. I. Hart).

shows a ground section of dentin and enamel adjoining a cavity previously filled with amalgam. Those canaliculi marked R, which pass close to the walls of the cavity, have absorbed the metalic sulphides of the filling, and carried them thru a part of the basis substance, clearly showing the anastomosing branches of these structures. But there is a very remarkable fact brought to light by this illustration, which, to my knowledge, has not been remarked before, and that is that only those canaliculi which are still in connection with the vital pulp have transported the stain thru the basis substance, whereas those at the right upper edge, marked R, having no such connection, show no pigmentation.

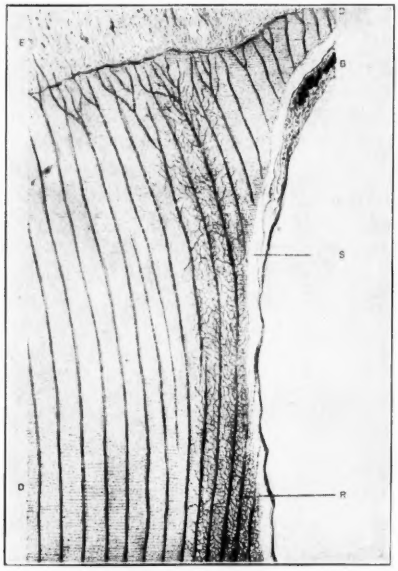


Fig. 4.—Drawing of ground bicuspid; longitudinal section, cavity previously filled with amalgam. E, enamel; D, dentin; B, border of cavity; S, solidified dentin along border of cavity; R, reticulum brought forth by the amalgam; R′, reticulum unstained as canaliculi not in connection with pulp, therefore no circulation at this place (Heitzmann).

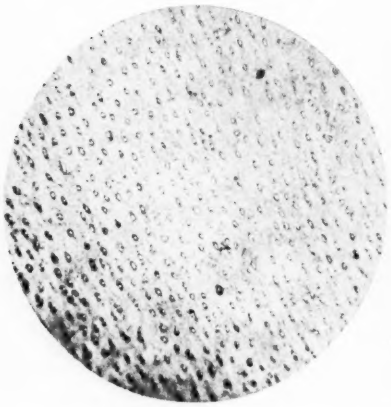


Fig. 5.—Photomicrograph of human dentin, decalcified; Delafield hematoxylin, x 300. Neumann's sheaths clearly defined.

The inevitable conclusion that must be drawn from this fact is that a circulatory system does exist in the dentin.

Up to this point, only diagrams and drawings of the minute structures of dentin have been presented in order to make the comprehension of the following photomicrographs of these structures more clear. Figure 5, an enlargement of 300 diameters of decalcified, human dentin, stained with Delafield hematoxylin, shows Neumann's sheath in cross-section. On very close inspection we note structures within, but the magnification is not quite sufficient to decide whether Tomes's fiber is of a solid or of a tubular nature.

Figure 6 shows unstained specimen of decalcified human dentin, photo-

graphed with ultra-violet light. Recall the controversy, before mentioned, as to whether Tomes's fiber is surrounded by a space or a differentiated basis substance. This photomicrograph furnishes to my mind, ample proof that the zone around the fiber is a space, for the light passes directly thru this area, being its brightest at these points. As I intend later to again mention this space, to which I attach an important physiological significance, I would suggest as a designation the *circumtubular space*. The enlargement of 1,000 diameters is sufficient to show the nature of the so-called Tomes's fiber; it is tubular without a doubt.

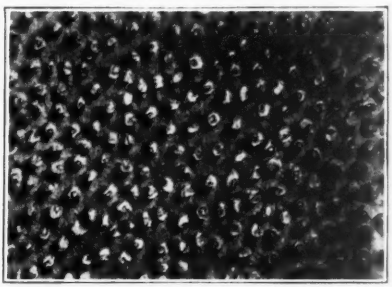
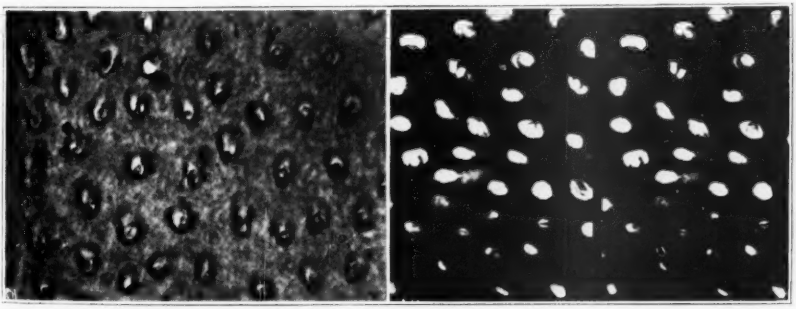


Fig. 6.—Photomicrograph of human dentin decalcified, unstained; photographed with ultra-violet light; x 1000. Proves circumtubular space (area between Tomes's fiber and Neumann's sheath) to be a space, as the light passes directly thru.

Figure 7 shows human decalcified dentin under an enlargement of 1,800 diameters, oblique illumination. We see Neumann's sheath and faint traces of the minute anastomoses of the odontoblastic tubes.

Figure 8, a decalcified dentin of an embryonic calf's tooth, shows very much larger canaliculi than in human dentin.

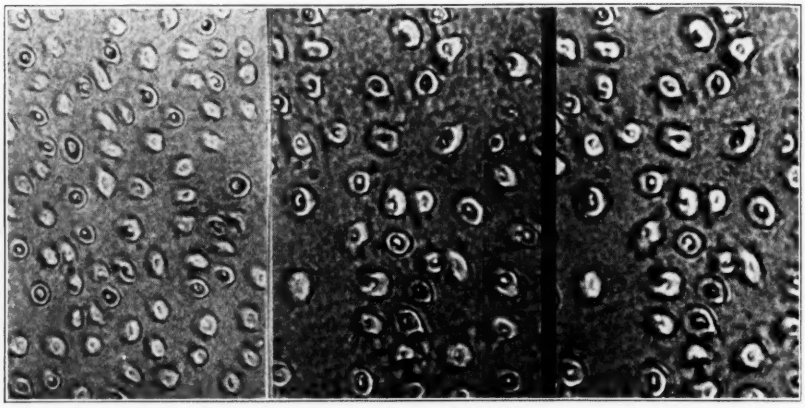


7 8

Figs. 7 and 8.—Fig. 7, photomicrograph of human dentin, decalcified; Delafield hematoxylin, x 1800; oblique illumination, showing tubular nature of odontoblastic process and traces of tubular anastomoses. Fig. 8, photomicrograph of embryonic dentin of calf's tooth, decalcified; Delafield hematoxylin, x 1700; basis substance stained intensely, so that Neumann's sheath is barely discernible; canaliculi much larger than those of human dentin.

The basis substance takes the stain much more intensely, so that it is only just possible to discern Neumann's sheath. The tubular nature of the odontoblastic process is clearly seen.

I now come to the dentin of sheep's teeth, and it is this species which has furnished the most wonderful photomicrographs. Figure 9 is an enlargement of 1,200 diameters, showing the odontoblastic tubes and Neumann's sheaths in cross-section. Note that not



9 10

Figs. 9 and 10.—Fig. 9, photomicrograph of decalcified dentin of sheep's teeth; Delafield hematoxylin, x 1200. Two concentric rings lying in basis substance, Neumann's sheath, and the fiber manifesting itself as a tube; inside of tube coagulated dentinal fluid. Fig. 10, same as Fig. 9, x 1700, with change of focus..

all tubes are empty, some show a residue of coagulated dentinal fluid, which at some places could be interpreted either as solid contents or even as nerve fibers in cross-section. At one place a faint trace of a circle within the odontoblastic tube is seen, but I believe this to be a cross-section of a bubble formed of coagulated dentinal fluid. These are points for future investigations; it is positive, however, to my mind, that the odontoblastic process is in the form of a tube whatever its contents may be, for the photomicrographs show two clear rings. At one corner, the tubular anastomoses of the odontoblastic process can be seen. It is difficult to reproduce these exceedingly delicate structures in the photograph, but they can be clearly demonstrated thru the microscope. They are infinite in number, and it is these structures which prevent the odonto-

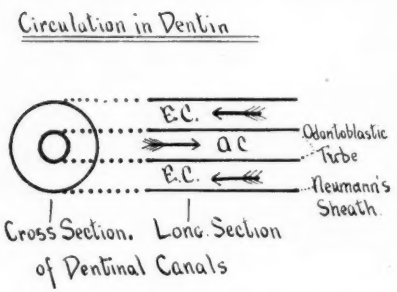


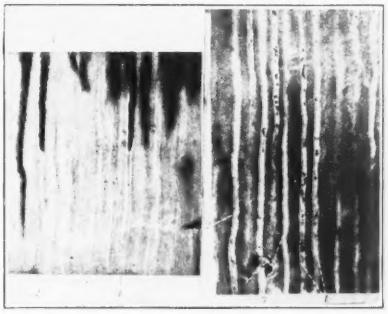
Fig. 11.—Diagram of Neumann's sheath and odontoblastic tube in cross and longitudinal section, showing plan of circulation in dentin. A. C. afferent current; E. C. efferent current.

blastic tubes from falling out of the microscopical specimens.

Figure 10 shows an enlargement of 1,700 diameters of the same species of dentin. The fact that under certain optical conditions a fiber may be made to appear as a ring and vice versa, under the microscope, might give rise to the objection that the tubular appearance of the odontoblastic process is a result of careful manipulation of the focus. By making two exposures of the same field, with a different focus, I have been able to clearly demonstrate that this tubular appearance is not due to any such manipulation.

The reason that only decalcified dentin has been shown, is that the calcium salts in ground sections cause such refraction that it is impossible to observe form and relative position of these minute structures. Besides this objection, there is also the difficulty of obtaining ground sections thin enough for this purpose. The most of these photomicrographs were taken from specimens with a maximum thickness of 5 microns.

I will now consider the physiological function of the odontoblastic tubes and Neumann's sheaths. There is no doubt that changes do take place in the dentin; otherwise how can the transparent zone, found around a carious area in dentin, be formed? It was my brother who called my attention to the fact that if we admit the presence of a circulation in the dentin two sets of tubes or canals must be demonstrated, the afferent and efferent vessels. To return to the transparent zone, it is produced by an added deposition of calcium salts. How do these salts reach this area? It can only be from the pulp by way or the odontoblastic tubes. We will call this the afferent circulation. When the calcium salts have been deposited, what happens to the fluid which held them in solution and carried them to that point? It cannot return to the pulp by means of the same tubes. Let us consider the structures which could assume this function the presence of Neumann's sheath is generally accepted. The existence of the odontoblastic tube has herewith been proved. Upon the basis of these facts my brother and I have evolved the following theory, explaining the efferent system of circulation in the dentin. Up to the present, no special physiological significance has



A B

Fig. 12.—Reproduction of photomicrograph of decalcified human carious dentin; Gram's stain (Kantorowicz): A shows proliferation of solid mass of bacteria in body of odontoblastic tube; B, isolated germs in advance of the proliferating mass.

been attributed to Neumann's sheath. In our opinion this sheath, however, forms the return channel for the fluid from the outer zone of the dentin to the pulp, representing the efferent system of tubes and thus completing the cycle of the circulation. Figure 11 shows in a diagrammatic manner, the two phases of the circulation in the dentin. On the left is seen a cross-section of a dentinal canal, and on the right, a longitudinal section, both showing Neumann's sheath and an odontoblastic tube. The space in the diagram, between Neumann's sheath (circumtubular space) and odontoblastic tube is marked E.C., efferent circulation, while the afferent circulation, marked A.C., takes place thru the odontoblastic tube.

Lastly, I will consider what influence a circulatory system in the dentin bears upon caries, and the desensitization of this tissue thru pressure anesthesia.

The manner in which bacteria travel along the canaliculi of the dentin has been, up to now, obscure. It is known, (Fig. 12 A.) that they proliferate in a compact mass along the course of the so-called Tomes's fiber, but it was impossible to understand how single germs could advance far beyond the main mass of the infection (Fig. 12 B.) If Tomes's fiber be regarded as solid, then it is indeed difficult to explain this mode of progress, but, if on the other hand, Tomes's fiber be a tube filled with fluid, it is plausible that bacteria may be carried away from the main mass of infection, thus explaining their isolation.

The fact that we always find bacteria *inside* of the odontoblastic tube, in their progress to the pulp, at first sight refutes our theory of circulation in the dentin, for my brother and I consider this channel as afferent, leading to the surface. This phenomenon, apparently incompatible with our theory of circulation, is due to the difference in the nutrient media which space and tube offer to the micro-organisms.

Just as long as we considered Tomes's fiber to be the bearer of sensation, the plan of reducing pain for the excavation of cavities by means of pressure anesthesia seems advisable. There is no doubt that we can obtund sensitive dentin thru a local application of cocaine and pressure. The fact that this procedure is successful proves that the odontoblastic tube is surrounded *in life* by the circumtubular space. Recall the controversy (shown in Fig. 1) as to whether this zone is filled with a differentiated basis substance (Roemer,

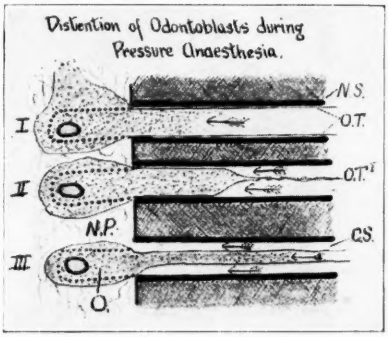


Fig. 13.—I, based upon theory that rigid odontoblastic tube (O. T.) fills entire lumen of canaliculi bounded by Neumann's sheath (N. S.); odontoblastic cell (O.) ruptures before anesthetizing fluid can penetrate to pulp and obtund. II, odontoblastic tube fills entire lumen, but is collapsible (O. T.); fluid contents of tube driven back and distend odontoblastic cell. III, author's conception. Odontoblastic tubes do *not* fill canaliculi entirely, leaving circumtubular space (C. S.) thru which anesthetizing fluid passes to nerve plexus of pulp (N. P.). Contents of tube driven back slightly, causing but little distention. Dotted line in odontoblast shows normal size.

Walkhoff), or a space only in the specimen, due to shrinkage (Fleischmann), or, as we claim, a space existing in life and having a physiological function. Suppose, for the moment, that the entire lumen of Neumann's sheath be filled with the odontoblastic tube (Fig. 13, I), what would result, if we apply

pressure anesthesia? If this tube be rigid the fluid can advance only in proportion to the distention of the odontoblast, and would reach the pulp only after the walls of this cell had been ruptured. This would certainly cause pain, as the rupture would have to take place long before the anesthetic action of the fluid could obtund the pulp. If, on the other hand, we assume that the wall of the odontoblastic tube be soft, and not rigid, it would collapse, thus preventing the cocaine solution from entering it (Fig. 13, II). In this case, the anesthetic fluid would force its way between the odontoblastic tube and the wall of the canaliculi and reach the pulp by this channel. But in collapsing the tube in its entire length, its contents would be forced back into the odontoblast, again causing a distention. Rupture might not ensue, but the vitality of the cell would certainly be impaired. In both these cases the distention of the odontoblast must cause excessive pain, which does not correspond with clinical experience. If, as we claim, the circumtubular space is present in life (Fig. 13, III), the anesthetic fluid can penetrate to the pulp without reducing the lumen of the odontoblastic tube, therefore causing but little distention of the cell; and the comparatively slight pain perceived by the patient, is due to the pressure of the anesthetic fluid directly upon the pulp tissue. By this explanation only can we understand why pressure anesthesia is successful and does not cause severe pathological changes in the odontoblastic layer of the pulp. It is also clear that the pressure need not be excessively high. The use of high pressure syringes employed for this mode of anesthesia is inadvisable, as the odontoblasts, even in favorable arrangement (Fig. 13, III), are distended to a slight degree. If the pulp is afterward removed, no harm results; should it, however, remain, then great care should be exercised as to the amount of pressure used to force the anesthetizing fluid thru the dentinal canaliculi. As the presence of nerve filaments in the dentin has been proved, we can safely say that these are responsible for the sensation in this tissue, and not Tomes's fibers. In order to obtund these nerves, it is by far better to apply the anesthetic to the nerve trunk than to its terminal filaments.

In conclusion, I wish to give you a resume of the facts brought out by my researches on the dentin:

1. Tomes's fiber is not a solid structure, but in the form of a tube; the name of "fiber" is therefore inapt; the *tubular process* of the *odontoblast* or odontoblastic tube designates its form and origin more correctly.

2. Connecting the odontoblastic tubes transversely with one another, along their course thru the dentin, there exists a system of fine branches which we designate as the *dentinal tubular anastomoses.* They are the finest division of the circulatory system, and are directly concerned in whatever metabolism takes place in the dentin.

3. The tubular character of the odontoblastic process explains the fact why single bacteria are found invading the so-called Tomes's fiber in advance of the proliferating mass, and why the use of high-pressure anesthesia for the desensitization of deep cavities is inadvisable unless the pulp is to be extirpated.

4. The contents of the tubular process, being identical with the cell contents of the odontoblasts, are in life, fluid. The death of the pulp or fixing agents used to prepare microscopical specimens, however, cause them to coagulate, thus giving rise to the error of regarding the odontoblastic tubes with their contents, as solid fibers.

5. The *circumtubular space* is, in fact, a space and not differentiated basis

substance, as claimed by Roemer and Walkhoff.

6. The circumtubular space transmits the efferent circulation, the afferent current passing thru the tubular process of the odontoblast.

7. Neumann's sheath exists. It surrounds the circumtubular space and lines the dentinal canaliculi.

8. Neumann's sheath, to which no physiological significance has, up to the present, been ascribed, herewith gains the function of limiting the circulatory fluid to a definite channel.

Discussion

Frederick B. Noyes, Chicago, Illinois: I have always considered Tomes's fibers as a solid, but a solid only in the sense that it was cytoplasm in the extension of the odontoblastic layer. We all know that cytoplasm is not a solid; it is a fluid or a semi-fluid, and it is, I think we may say, always in circulation in a living cell. It is a fluid, not a solid, and so when some of us have said that the fiber of Tomes or the odontoblastic fiber was an extension of the odontoblastic layer, it was the same as saying that it was a fluid. Then the essayist made a statement that semed to be in opposition to it. The more I have worked on the lymphatic circulation in relation to the dental region, the more I have been convinced that, while the fiber of Tomes was much larger in life than it appeared to be in the microscopic section, the work of Dr. Dewey and myself on the lymphatics several years ago certainly indicated that there was a lymphatic circulation in the dentinal tubules, and that the maintenance of the quality of the dentinal matrix, which we know is dependent upon a living pulp, is thru the agency of the living cytoplasm which must in its flow carry nutrient materials into the fibrils and between the fibrils and the wall which contains them. You see that comes very close to being the same thing that the essayist has advocated. I have had in mind the doing of certain experimental work which so far has not been undertaken, but which, when carried out to completion, will, I believe, give us some very important additional evidence on the relationship of Tomes's fibers and the dentinal tubuli, and the relation of both to the nutriment of the dentinal matrix and the conductivity of anesthetizing agents all of which tallies very closely with the statements of the essayist as I interpret their meaning.

I still have a very strong feeling that the real solution of this question can never be solved from the study of the adult tissue. Only such men as the essayist can appreciate at all the technical difficulties that are involved, and the reason we have had so many apparently absolutely conflicting statements as to the minute anatomy of these structures is due to the difficulty of interpreting the appearances under exceedingly high magnifications and under the most complicated technical conditions.

Russell W. Bunting, Ann Arbor, Michigan: With Dr. Rickert, I feel that the paper is one that will take considerable time to digest. The point that strikes me most forcibly is the fact that in most of the illustrations, there were certain of the dentinal fibrils, as we call them, which showed a distinct tubular arrangement, while others appeared to be solid.

I partially appreciate some of the difficulties experienced by Dr. Bodecker in making those sections. No one who has not attempted this kind of work can really appreciate what it means to study a minute organic structure surrounded by heavy inorganic material which must be decalcified in order that it may be cut; and to put this material in condition to be cut without producing changes in those minute organic structures, is extremely difficult.

It seems to me that the study presented has been most opportune, because just at this time we are so deeply interested in the contents of the dentinal tubuli, striving to determine what changes take place in the dentin subsequent to the death of the pulp. Is the dentin to continue to be a living, functionating structure which undergoes metabolic processes; does it degenerate, or does it remain *in statu quo?* This study which Dr. Bodecker has presented has materially added to the information which we already have on this subject.

In the work done by Dr. Rickert and myself, Dr. Rickert furnished the chemical knowledge and I contributed some experience in histology. We attempted to permeate the dentin of various teeth with silver solutions, as a result of which we noted this: That there were many teeth which the silver would permeate beautifully, either by capillary attraction or by osmosis, diffusing thru the dentinal tubuli, but we noticed that there were certain blank areas into which one could not get the stain to permeate at all. In other words, certain tubuli would take the stain up beautifully, while others would not. And as I saw these sections I wondered if it had occurred to Dr. Bodecker that possibly we have various kinds of tubuli, various kinds of fibrils, connected with the odonto-

blasts, some of which are tubular and some of which are more or less cytoplastic—a solid and continuous cytoplasm—or whether several different form of fibrils may exist.

Also as to the manner in which the so-called transparent zone is formed in the calcification of the dentinal tubuli, we invariably find that some tubuli do not calcify at all. Some fill with calcium salts and become apparently homogeneous, and others do not. Some of these things suggest themselves to me, when considering the form of dental fibrillar structures.

V. A. Latham, Chicago, Illinois: No one who has not attempted this kind of work can realize the difficulties connected with it. I have had some experiences similar to those of Dr. Rickert and Dr. Bunting, with special methods of staining and secured some results. I have some slides which show some of the nerve filaments going into the interdentinal spaces as a distinct structure. I have also been able to show what appears to be a single polar cell, which I presume is a modified pear-shaped odontoblast in the granular layer of Purkinje, with processes running back toward the dentinal tubules.

The essayist said that there are bacteria in the tubules. That is very common, but denied by some. Upon examining coronal parts, we can find enough micro-organisms to enable us to identify them. I have seen specimens where the tubuli are very wide. If you can get a section of these, by grinding the crown down and keeping it under an isotonic solution all the time, allowing absolutely no drying, you can by using Barber's method, pick out a bacterium. Therefore you can isolate the types to a certain extent.

Again, when you get to the main trunk of a nerve fibre or odontoblast, you may trace it far enough down until it becomes motor, and finally it may be a fiber of the sympathetic system. In other words, you have the motor endings, and you can go down until they become sensory fiber or dendrites. We are saying this merely as a supposition. In the cases on which I have worked so far, I have been able to demonstrate large multipolar nerve cells from the pulpal surface which have from one to five distinct branches of the main cell, running clear down into the tubule. If those nerves or multipolar cells can descend and carry multi-processes, they can also become simple processes. This is more prone to occur in the granular layer.

There are several points that the paper has not made clear; not only the question of the absorption or of circulation for the method of anesthesia, but the point brought out by Dr. Noyes as to the lymphatic supply, and it also opens up the question of the presence of bacteria. I heard a statement made which expressed doubts as to whether bacteria were found in the tubules. Dr. Bodecker, and others also, have proved that.

Dr. Mummery's work, I am happy to say, originated considerably later than the work on the American side. Mummery's work was postponed about ten years after much had been done on this continent. We have had demonstrations here by Dr. Talbot and others, but published mainly in the medical journals. I have sections in which I have traced the circulation into the enamel of teeth, in middle age, a few in cases of old age, and also those in youth.

No doubt Dr. Bodecker is familiar with the statement which we so often hear that teeth are all of the same structure. But that is absolutely erroneous. I doubt if there are two teeth out of a large number that will react the same. I have sometimes examined one hundred teeth before I have found a second one that would give me the same result as the other. Teeth are very different. It is difficult to secure for exerimental work what we would call a normal tooth, and unless we get a basis of normality, how are we going to know the difference between the pathologic and the normal?

Dr. Bodecker (closing): There is an apology I want to make if I have omitted mentioning some of the recent experimental work. I have been cut off for the last four or five years, during which time I have not seen any dental literature, and so it happened that I did not know Dr. Noyes' publication about the lymphatic circulation. Of course, Tomes's fiber has been considered as a circulatory organ, and if you concede a circulation going out from the odontoblasts, you have to account for a return current, you cannot consider it always going out from the odontoblasts and never coming back. As to this special sheath, if you want to hold onto that as a fiber, then I believe you have to admit that there is a separate sheath around Tomes's fiber, or that it is comprised of two different parts; that is, an outer sheath and an internal substance.

Dr. Noyes stated that the structures are very small. That is true, and only those who have seen them thru the microscope and really know their size can appreciate their minuteness. If we consider that the tubular process of the odontoblast is 1/25,000 to 3/25,000 of an inch in diameter and Neumann's sheath but slightly larger; it is easily understood that, when one of these structures are missing, it is difficult to say which the remaining one represents.

Dr. Bunting said that he seemed to see that some of the odontoblastic processes were

tubular, and that at other points they seemed to be fibers. That is also true. Where they appear as fibers, it is because the contents of the tube have been coagulated by the fixing agents, when, of course, the substance is solid. To make a rough comparison, it is just as tho I take an egg and boil it; you would not consider an egg solid until it was boiled; a boiled egg is solid, while the raw egg is fluid.

Dr. Latham spoke of the importance of studying the histological character of the tissues of teeth. It has been my conviction for years that we do not as yet know all of the histological constituents of these tissues, for the enamel, especially, shows a varied appearance and we can not tell which condition is histological and which pathological. There is no doubt that we cannot consider pathology before we know the histology of the minute structures of the dentin and enamel. As Dr. Bunting said, sometimes there is a difficulty in injecting and staining with silver nitrate solution. There are some tissues you simply cannot penetrate with any agent. Whether these are pathologic or physiologic, we do not know as yet, because we have not completed our knowledge as to the histological constituents. That different kinds of teeth exist, all clinicians know. The histologist, especially the man who has had no clinical experience, says there is no difference as to the hardness or softness of teeth, that it is impossible that there should be; but the clinician knows that there are so-called "hard and soft teeth." There *must* be a difference, the enamel can change. The teeth of healthy persons being hard, they are resistant to decay. If the individual becomes ill, it is not long before the teeth become more liable to caries. My brother did not have any caries for about seventeen years; then suddenly we found eleven new points of caries. Two months later a nervous intestinal catarrh was diagnosed. I have no doubt that the teeth are effected by constitutional disturbances and harden again when the body becomes healthy.

The question was asked about the continuation of circulation into the cementum. I have no experience with cementum in this work, but I believe there is a circulation between the dentin and the cementum. I have had the honor of being the first to prove the existence of organic matter in the enamel and its connection with the dentin. I have been able to show it under the microscope in its original form, with very little distortion. Thus enamel is connected with the pulp by way of the dentin.

It has further been asked how far the circulation from the cementum could furnish nutrition for a pulpless tooth. I believe only up to the line of the gingiva. I do *not* believe that nutrition from the pericementum and cementum would suffice to keep the dentin of the crown in a normal condition, for I consider this dentin to be in a dead or a live condition according as the pulp is dead or alive.

PRESERVATION VERSUS RESTORATION

By ROBERT R. GILLIS, D.D.S., Hammond, Indiana

(Read before the National Society of Denture Prosthetists, and the American Society of Exodontists, August 1-13, 1921)

INASMUCH as the denture prosthetist is called upon to render service after the exodontist has completed his service, we find the two specialties have problems to solve, methods to evolve, ultimate results to attain that make their interests mutual.

For several years past, I have been following a method that provides immediate denture service for those patients who must lose their natural teeth. The success of this method convinces us that there are certain reasons underlying its success, reasons which have not been given due consideration in the past.

Today almost all dentists and practically all patients cling to the belief that a period of weeks or months must intervene between the time of extraction and the time when dentures can be worn.

During that edentulous period we believe great injury is unwittingly done to the patient and the denture-makers' problems are unnecessarily multiplied.

This paper will attempt to point out why such a waiting period is unnecessary and injurious.

In the days of the immediate past, the dentist studied his denture patient edentulous; registered the high and low lip lines to determine the size of the artificial teeth; guessed which one of the four classic temperaments (nervous, lymphatic, bilious, sanguine) should determine the shade of the teeth; compromised on something "small and white" to please the ladies who had been without teeth so many months that time had effectually effaced any memory of the true color or dimensions of their lost natural dentures; and finally, used such teeth as his selection afforded. A very definite technic!

The patient's edentulous mandible had assumed a closer and closer relation to the nose as the hinges became progressively looser in their motions; the muscles of mastication had lost tone and changed somewhat in contour; the muscles of expression had suffered similarly because the framework over which they once operated had been wrecked; possibly crowsfeet had appeared at the outer corner of the eyes and in front of the ears; a deep depression line extended diagonally downward and outward from the alae of the nose and the corners of the mouth; the entire mouth had puckered up a bit; the alae of the nose had spread a bit upon the face and the tip of the nose had hooked down a little as if trying to do its share in an effort to meet the chin halfway.

Prevention is the high aim in the healing arts today; so let us apply it in our denture service to the end that our patients shall accept the ultimatum of

our 100 per cent vitality faddists and enjoy their declining years with the full knowledge that their age cannot be guessed from their teeth.

Possibly the picture thus drawn to illustrate the accomplishments of the past in denture prosthesis may seem rather pessimistic to some. I do not intend that it should. Rather is it our purpose to contrast the old and the new in the hope of impressing the advantages found in the new.

Many attempts in past years were failures when examined in the light of present day knowledge. But if for a failure we can find a cause, then by its correction learn a lesson and thereby avoid that pitfall later, we are making progress.

FAILURE

Failure's just a resting place
On the road to Try Again;
Just a slackening of the pace
And a pause for sturdy men;
Just a temporary halt
On the march to wealth and fame,
Where you can correct the fault
And go on to play the game.

'Failure's not a thing to dread,
It's just a hint to you
Ere you dash too far ahead,
To be careful what you do;
It's just the sidetrack where you wait
For the passing fast express;
Get up steam! The run is straight
Out of Failure to Success.

EDGAR A. GUEST.

All of us who have constructed many dentures will honestly admit that we have met failure in such cases as described in the foregoing paragraphs; but most of us are so busily and hastily engaged in all sorts of restorative dentistry that we have failed to take advantage of being laid out on the sidetrack of failure. That should have been grasped as an opportunity for studying causes and effects in an effort to eliminate failure next time such a case presents to us.

Study *cause* and *effect* diligently. For there were causes leading certainly to those undesirable effects and, by understanding causes, we might anticipate and *prevent* such effects.

In the mind of nearly every denture patient, *appearance* is uppermost; efficiency is usually a subordinate consideration. A happy combination of appearance and efficiency affords the ideal in artificial dentures.

My idea of successful artificial dentures would not meet with the approval of some admitted idealists for there are those (admitted idealists) who would mold each and every case to a fixed pattern or standard form regardless of what had been the previous natural condition, always recognizing only certain definite lines, contours, and tints as normalcy.

That is an exalted ideal; but I prefer a lesser aim, one th t is more easily within the bounds of possibility of attainment, for in the making of artificial dentures we can grasp only what is within our reach and our reach is often shortened or handicapped by the human frailties of our patient.

I have no quarrel with the denture prosthetist who is satisfied only when he has provided his patient with an ideal restoration, ideal as to tooth form, shading, arrangement, etc., as preached by the exalted idealists; but I feel justified in providing my patients with dentures that probably would not measure up to that high standard but which would be a more accurate duplication of that patient's natural dentures—something that their friends would say makes them look natural.

Those of you who have been privileged to visit Mt. Vernon and study the portraits of Washington and particularly the portrait that hangs in his Masonic Lodge hall at Alexandria realize immediately the great difference between those life-like pictures and the idealized

Washington of Stuart, with which we are most familiar. There is a very great difference. The Alexandria portrait is far less pleasing to look upon and yet Washington and his friends expressed a preference for it as compared with the portrait of Stuart.

If a thing can be ideal *and natural,* it is well and good; but in things like prosthetic dentures that have such a great influence on personal appearance, I find I can afford most satisfaction by closely reproducing the natural normal conditions that existed before extraction.

As the teeth have become worn off thru long usage—or possibly lost entirely and replaced with artificial dentures that are too short—the head of the condyle has been progressively driven backward, assuming an abnormal relation with the structures forming the anterior wall of the external auditory meatus, resulting possibly in impaired hearing.

Impairment of hearing and some nervous disorders have been recognized as sequelae of the shortened maxillo-mandibular relation and have been relieved in the same manner.

This latter condition is perhaps due to changes that take place in the soft tissues of the floor of the mouth and pharynx following the loss of all the teeth. The soft tissues inside the mouth and throat which are attached to and supported by the mandible will become disarranged and their functions impaired when the maxillo-mandibular relation is much shortened.

In whatever degree artificial dentures are built to a bite shorter than the natural bite for that particular patient, in like degree will these functions of the surrounding parts be disturbed. And conversely, relief from such disturbances may be expected to follow the wearing of properly built dentures.

Dr. Prentiss of the University of Iowa has called our attention to the destructive changes which take place in the inter-articular cartilage of the temporomandibular joint after a marked shortening of the bite.

This cartilage is designed to serve as a buffer between the articular surfaces of the head of the condyle and the glenoid fossa. With a shortening of the bite, it is apparently subjected to a condensing pressure, ever increasing as the bite shortens. Cases have been reported wherein this cartilage has become an annular cartilage and others wherein the destruction has been almost complete.

Such extreme loss of structure could probably never be repaired and the functional impairment resulting therefrom could not be remedied, *but we are impressed with the necessity of preventing any such maldevelopment.*

Dr. Prentiss tells us that the temporomandibular articulation may become impaired in a very short time; that some repair may naturally follow the wearing of proper dentures; but that the dentist who makes up his artificial dentures by the commonly practiced methods of today when there is already a partial or complete loss of the meniscus, is comparable to "a mechanic who adjusts the lock of a door when the hinges are off."

In medical practice of today, the highest ideal, the foremost function to society, is accomplished in the prevention of disease; the second ideal, the next function in importance, is exercised in the cure of disease; while the third ideal, so far down the scale that it is most commonplace, is found in the alleviation of suffering. We dentists in our denture service have often secured results that would scarcely allow us to stand with this third class.

Probably three considerations have

been responsible for the present popularity of "minor oral surgery"—each one fully justified if wisely applied; but unfortunately possible of easy abuse. First the anesthetic procaine. For many years we had to depend upon cocaine (or other drugs no more reliable) for a local anesthetic. Its limitations and dangers were recognized by nearly every dentist and most of us sought to avoid its use. Then came procaine and the nerve-blocking technic and a new and safe avenue was opened whereby pain could be avoided. Naturally we hailed its advent with delight.

Then the better understanding of the X-ray and increased knowledge of hidden pathology of the jaws coupled with a realization of the subtle evils of such pathology made us ready to employ more surgical procedure than ever before.

As the third consideration, the increased number of teeth extracted by our 100 per cent vitality faddists compels increased interest in oral surgery and incidentally a revival of denture prosthesis. The dentist who constructs the full dentures has always met some difficulty in cases of recent extraction because of the ungainly ridge contours encountered.

But some dentists, in their enthusiasm, have abused or overworked the situation to the end that some mouths have been wrecked in being made edentulous.

I would condemn alveolectomy but commend alveolotomy, for in this latter term I recognize the removal of a relatively small amount of labial and buccal process which will establish a ridge contour favorable to denture adaptation more quickly than nature alone and unaided can establish it.

Some of our oral surgeon friends have evidently applied that principle of operative dentistry pertaining to cavity formation "extension for prevention" in some of their surgical technic. They have judged that the elimination of an apical granuloma of 6 mm. diameter requires the sacrifice of all the labial or buccal plate of process from the alveolar border clear up to and above the affected area. I feel sure that the making of a fenestra, as in an apicoectomy, would permit the removal of all pathological tissue and at the same time preserve a bridge of bony tissue that would serve as a matrix in the formation of new alveolar structure. Thus we would have a better continuity of ridge contour and avoid those ungainly sunken areas.

It would be a very aggravated case that would necessitate such radical treatment as is too often given now to the removal of simple chronic apical infections; seldom does a case present such pathology as would require the extensive removal of the labial or buccal plate in toto.

If a case presents an unusual pathological condition, the particular field involved should be operated upon previous to the operation on the rest of the mouth.

Just two considerations determine how much process should be removed: contour and pathology.

We consider those contours of the ridge objectionable that interfere with the placing and withdrawal of impression material or interfere with the ready placement of the finished denture. Most objectionable contours are in the horizontal plane, lateral projections. These should be cut back just enough to make them passable for the materials mentioned above. Vertical projections are seldom in the way. Vertical projections cease to be objectionable when the bite is opened to its proper distance. The only vertical trimming would be of the tiny points or spiculae between the

alveoli. This answers some who would cut away prominent tuberosities (vertically) in mouths where artificial maxillary dentures have been worn for years in occlusion with just a few mandibular front teeth, resulting in excessive atrophy of the front part of the maxillary ridge. As one exception to this statement about vertical reductions, we do encounter cases in which the front teeth are overprominent and it is desirable to set the maxillary incisors higher than the natural ones were. In such a case, it is well to impress upon the patient in advance that he will not look natural to any of his friends or family after the work is completed.

A very serious error on the part of some oral surgeons has been their reduction of the lingual or palatal plate of process. These borders should be merely smoothed off but not reduced materially. A study of many cases months after operation, convinces me that the surgeon who reduces the lingual alveolar borders errs in proportion as he reduces them. Some operators apparently forget that another dentist must follow with denture construction when healing is complete and their enthusiasm carries them so far in tissue removal that the result can be carried by no other name than wanton destruction.

Experience in relining has taught us that whatever change occurs will be evident in the labial and buccal sides of the ridge and that the lingual or palatal changes only enough to accommodate the falling crest of the ridge. We would therefore advise that in the operation of alveolotomy the lingual and palatal rim of process should be merely smoothed off but not reduced materially.

Bibliography

Brown, L. P., *Dental Cosmos*, December, 1920.

Gillis, R. R., *Dental Summary*, August, 1920.

———, *Jour. Nat. Dental Assoc.*, August, 1921.

Monson, G. *Jour. Nat. Dental Assoc.*, May 1920.

Orton, F. H., *Dental Summary*, April 1919.

Prentiss, H. J., *Dental Cosmos*, June 1918.

Ruyl, J. P., *Dental Cosmos*, May, 1918.

Summa, R., *Dental Cosmos*, June, 1918.

Wright, W. H., *Jour. Nat. Dental Assoc.*, December, 1920.

REPORT OF RESEARCH COMMITTEE, FINANCED BY THE MICHIGAN STATE DENTAL SOCIETY[1]

Report submitted by U. G. Rickert and Chalmers J. Lyons

By U. G. RICKERT, D.D.S., Ann Arbor, Michigan

(Read before the Michigan State Dental Society, Detroit, Michigan, April 11-15, 1921)

SO MUCH has been said about pulpless teeth and infected teeth in recent years that many have come to look upon the two conditions as identical. Dr. Josef Novitzky has ben repeatedly making the statement that pulpless teeth never remained sterile for a longer period than six months. His claims have received wide publicity in both medical and dental journals and one of his contributions has been reprinted, in part, in the scientific columns of the *Literary Digest*. Many other attempts have been made to confirm the extreme view that pulpless teeth will not remain sterile. This fact coupled with the work of Collins and Hartzell, demonstrating the possibility of certain vital teeth having infected pulps, added still more confusion to the unsettled status of pulpless teeth.

Because of this confusion and the fact that the larger part of the profession has neither the clinical nor the laboratory facilities to prove or disprove the proposition, Dr. Lyons and I began investigating the subject. Early in 1919, we developed a technic for culturing teeth without extraction. We were especially interested in finding out whether pulpless teeth are always infected or not. We were confronted daily with radiograms in which certain teeth showed more or less pronounced rarefied areas. The general conception of such areas is that they are infected. We were suspicious of this ourselves and decided to put it to the laboratory tests.

The generous contribution of the Michigan State Dental Society made possible the services of L. Coleman Ludlum, who has had a very broad bacteriological training. With his assistance we were able to study a much larger number of cases than could have been done otherwise.

There is no phase of the work we have undertaken that requires such painstaking effort to avoid contaminations as that of getting the culture material from the suspected field. That part of the experimental work of this report has all been done by Dr. Lyons and members of his staff.

We will first describe the surgical technic of Dr. Lyons for obtaining cultures of teeth without extraction. It will be seen that this is often desirable where radiographic findings are good but because of some secondary evidences of infection the operator demands more substantial proof that the teeth are or are not infected than can be had from radiograms alone.

The Technic For Obtaining Cultures

The area about the apex is first located by the aid of a suitable radiogram, the field is made aseptic with iodin and alcohol, then an incision about one

[1]A report of two hundred teeth cultured in the Research Laboratory of the College of Dental Surgery, University of Michigan.

centimeter long is made transversely over the apical area, the sides of the incision are retracted, the apical end of the tooth exposed and curetted, and the

1 2

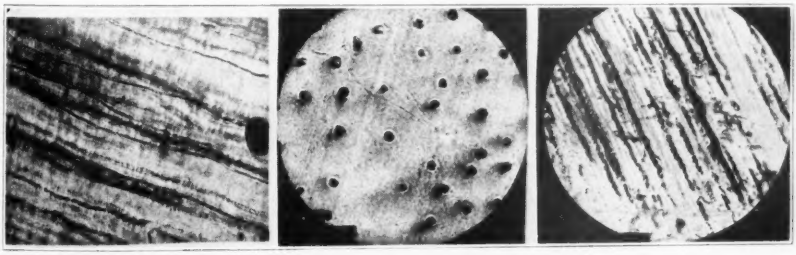
Figs. 1 and 2.—Fig. 1, organisms most commonly found in apical infections. Fig. 2, typical flora of the saliva (from the Miller collection).

curetted material is then introduced in the dextrose brain broth to be described later.

Radiograms taken a year or more after taking cultures in the above mentioned way give evidence that in cases where there was no infection and the teeth were not extracted, regeneration was normal and favorable.

We have found it much more difficult to avoid contaminations where cultures were made from extracted teeth. Experiments tried with iodin and alcohol for sterilizing the cervical areas convinced us that it was next to impossible to get this field aseptic. Because of this fact, it is difficult to get cultures from multirooted teeth without alveolectomy, and even this operation is attended with too many possible dangers of contaminations. For example, in raising the flap, the surgeon begins at the cervical region and in carrying his instruments up over the apical area he is almost certain to carry contamination from the neck of the tooth. We have watched several operators take cultures this way and we are certain that their high percentage of positive findings may be explained as contaminations. Taken as most cultures are taken, we would be very much surprised if many of them should prove to be negative. The types of organisms described as those found have usually offered sufficient evidence of contamination. The movements necessary in extraction of multirooted teeth produce a sort of pumping effect which carries before it infection from the cervical areas. We have been unable to get satisfactory cultures from such teeth.

It is often desirable to take cultures thru the root canal. This is also quite difficult to do without contamination. A few years ago, much was said about canal dressings not remaining sterile for more



3 4 5

Figs. 3, 4, 5.—Fig. 3, longitudinal section of dentin, illustrating why it is so difficult to sterilize dentin by ordinary methods. Fig. 4 cross-section of dentin, highly magnified taken with ultra-violet light. An ideal retreat for bacteria. Fig. 5, longitudinal section of infected dentin. Note bacteria in dentinal tubules. (Figs. 3, 4, and 5 are from the W. D. Miller collection.)

than a few hours at best, and we too came to the same conclusion, for most of the dressings we then cultured were positive if they had been in the canal long enough to become diluted by diffusion. We now know that many of our earlier cultures were positive because of faulty technic. The method of taking cultures thru the root canal is even attended with more difficulty and uncertainty than is met in going thru the process for culture material. The technic that we are now using was developed not as one suitable to be used for culturing all different

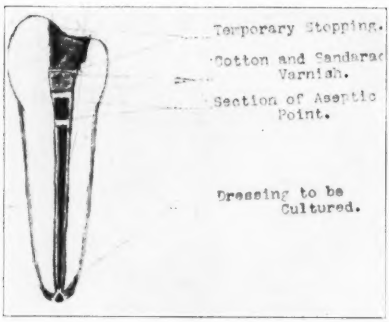


Fig. 6.—Method of sealing in dressing for culturing.

cases that might be presented, but to be used in favorable cases to determine whether dentin and involved apical areas can be sterilized if once infected. It will be evident that this method will be applicable, however, in many cases where a culture is desirable. (It reduces failure to a minimum). Thus far, our experiments have been carried out on single-rooted teeth only, but the principles involved may be modified to suit the case and might be of culturing multirooted teeth *as* well.

The Technic of Taking Cultures Thru the Root Canal

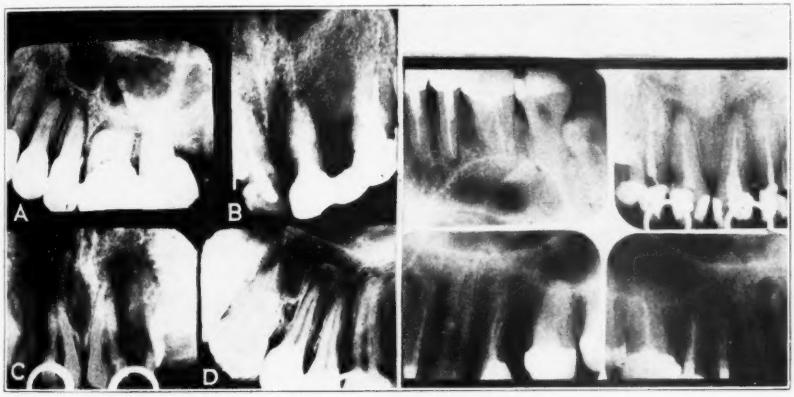
The canals are first opened large enough to be readily accessible. The canal walls should be cleansed with alcohol or hydrogen dioxide. The treatment is introduced on an aseptic paper or cotton point of a length not to exceed two-thirds the length of the canal, above this toward the occlusal orifice, place a short section of the dry thickened end of a sterile cotton point; then above this place cotton moistened with sandarac varnish. The cavity is next sealed with either cement or temporary stopping. In taking the culture, the tooth and adjacent teeth are isolated, dried and treated with tincture of iodin. The temporary stopping is removed and the cavity moistened with iodin; the sandarac varnish stopping is then removed and this portion cleansed with alcohol. The last dry pledget is then removed, and with a barbed broach the dressing to be cultured is carefully withdrawn; it is seized just above the point of contact of broach with a sterile cotton plyer; the broach is released, the outer end released from the broach cut off to the plyers and the remaining part of the point, which is the apical end, is introduced into the culture media. In this way the upper part of the canal has been made safe for the withdrawal of the dressing to be cultured. The procedure at first looks tedious and difficult, but is less so than it would appear. Those of us who have seriously tried bacteriological work of parts of the mouth, have found it to be extremely difficult. With the most painstaking efforts discrepancies will occur that can be explained only as failure in technic. Putting it into a few words, we would say that it is very easy to get positive cultures of teeth but mighty difficult to get negative ones.

Media and Method of Making It

The original media used was selected to grow streptococci because that organism is the one most often described and met with in apical infections. The first media used was veal infusion with 1 per cent peptone, 1-2 per cent Nacl, and several small pieces of calves' brains. Mr. Ludlum is of the opinion that the reaction of the media is a very important

factor in culturing streptococci. He has been experimenting with the reactions best suited for culturing streptococci and has found Ph 7.4 as indicated by hydrogen-ion concentration determination as the optimum. This applies to hemolytic and green-producing streptococci, or viridans, a misnomer for strains of the later type.

The blood agar we used was made in the usual way, 5 per cent defibrinated human blood and 1.8 per cent agar. Our



7 8

Figs. 7 and 8.—Fig. 7, rarefied apical areas of both infected and noninfected types: A, noninfected chemical trauma; B, noninfected mechanical trauma; C, infected, apical streptococcus infection; D, infected, a typical staphylococcus infection. Fig. 8, films taken six months after treatment. All four films are of the same patient. All rarefied areas were cultured and found negative. Phenol necrosis or chemical trauma.

medias were tested with known strains of streptococci hemolyticus, green-producing streptococci, and types of pneumococci.

Recently we have been using a media made according to a formula furnished us thru the courtesy of Dr. Rosenow. This is the Difco dehydrated media eight grams in one liter of water, 2 per cent dextrose and Andrades indicator. The reaction of this media is about Ph 6.9; this, however, is modified slightly by the indicator added. The bouillon is tubed in eight by five-eighths inch tubes to which three small pieces of brain and three pieces of crushed marble are added. It will be evident that the brain with the long tubes favors anaerobic growth. Many pathogenic strains are difficult to grow when first taken from the body. Anaerobic and semi-anaerobic conditions are best suited for this work. For a time we took two cultures of each case and incubated one under strictly anaerobic conditions. This proved to be unnecessary and was discontinued. Even tetanus has been grown in this way. Of the two culture medias described above, there is no special choice, for one is as good as the other.

Types of Teeth Cultured

While our report includes a few patients with no evidences of low-grade infection, the greater part of the cases to be reported are patients with more or less pronounced secondary changes. In the cases where there were only a few pulpless teeth and radiographic findings were good, the regular routine was cul-

turing with extraction. If the findings were positive, and the patient was referred back to us for extraction we again made cultures in many cases from the apices and root-canal contents. In this way we were able to check up the several methods employed in taking cultures. We might add here that the percentage of positives when taken from the apices of freshly extracted teeth is much higher than it is when cultures are made from the contents of the pulp canals. The percentage of the latter corresponds more closely to those made thru the process before extraction.

Many pulps of freshly extracted vital teeth were cultured as well as the canal contents of non-vital teeth. In culturing teeth with vital pulps previous to extraction, the apices were coated with paraffin and the whole tooth then immersed into tincture of iodin for one-half minute. It was then taken out and after the excess tincture of iodin was shaken off it was placed into a sterile petri dish and allowed to dry for about five minutes. With sterile bone cutters, the tooth was opened to the pulp canal and the pulp removed and placed into bouillon and incubated.

Results of Cases Cultured

It must be evident that the majority of patients submitting to the taking of cultures are referred patients. More than 80 per cent of the cases included in this report gave histories of arthritis, neuritis, myocarditis or nephritis. Arthritis is the most common suspected secondary effect.

Results of more than two hundred pulpless teeth cultured up to April 1, 1921 (see Table I) including patients giving no histories are interesting in that 51 per cent were positive and 49 per cent negative. More to the point, however, we have the figures of those giving one or another of the above numerated diseases; here 67 per cent were positive as against 33 per cent negative. Of those having no evidence of systemic diseases, 26 per cent were positive and 74 per cent were negative. Referred cases where no history was known were only included in the sum total of first calculations. In all calculations, we have included positive cultures even tho they were suspected of contamination. It would have been allowing too much of the personal element to enter into the report to have ruled out all that in our opinion were contami-

TABLE I*

Report of All Teeth Cultured Including Known Contaminations

Bacterial Report of Research Department to April 1, 1921

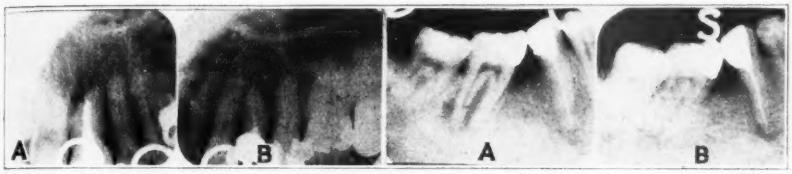
Pulpless teeth cultured. Cases giving history of myocarditis, nephritis arthritis or neuritis.	Positive 67%	Over all cases
	Negative 33%	Positive 51%
Cases with no evidences of the above-mentioned diseases	Positive 26%	
	Negative 74%	Negative 49%
Vital teeth cultured. large cavities and pyorrhea. No further histories taken.	Positive 19%	
	Negative 81%	

*This report includes all cultures made. Some of the above positives may be contaminations.

nated for all cultures were made with the same degree of care.

The vital teeth that were cultured subsequent to extraction in the majority of instances came from hopeless cases of pyorrhea. The minority were teeth with large cavities or those of no strategic importance; 19 per cent were positive and 81 per cent negative.

Inasmuch as we have demonstrated that many pulpless teeth are infected, the most natural question to arise is, Can such teeth and involved areas be made aseptic, and if so, how long will they remain aseptic? This part of the work is only in the making. Not enough cases have been studied from which to draw conclusions, but about twenty-five infected teeth have been treated and cultured. Trusting that no one will draw too definite conclusions from so few cases, we will give the results, because the information is somewhat enlightening as to the treatment of certain types of infected teeth.



9 10

Figs. 9 and 10.—Fig. 9, pulpless teeth that have served many years and remained sterile: A, treated in 1903; B, treated in 1889; was abscessed; apical area curetted at time of treatment. Fig. 10, A, tooth sterilized with reduced silver; B, same tooth fourteen months later.

Results of the Treatment of Twenty-five Infected Teeth

Only one drug was tested. This was chloramine (paratoluene-sodium-sulphochloramide), a preparation donated to us thru the courtesy of Parke Davis & Co. for experimental purposes.

The teeth treated were selected cases, single-rooted, those that had, as yet, only slight destruction of the enveloping membrane. Many cases were in the acute stage. Where there was pus, this was allowed to drain by leaving the tooth wide open. When all soreness disappeared, the treatment was begun. As stated elsewhere, the tooth was opened to get ready access; the canal cleansed with alcohol or hydrogen-dioxide and the treatment introduced as previously described. In some of the most difficult cases, our first treatment consisted of placing a small pledget of cotton moistened with dilute tricresol in the very outer end of the canal and instead of sealing in this treatment with cement or temporary stopping, we closed the opening with a loose seal of sandarac varnish and cotton. This loose seal prevents pressure from gases of either the treatment of putrefactive sources and

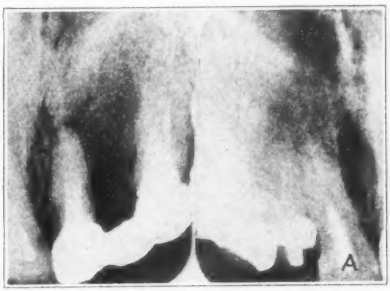
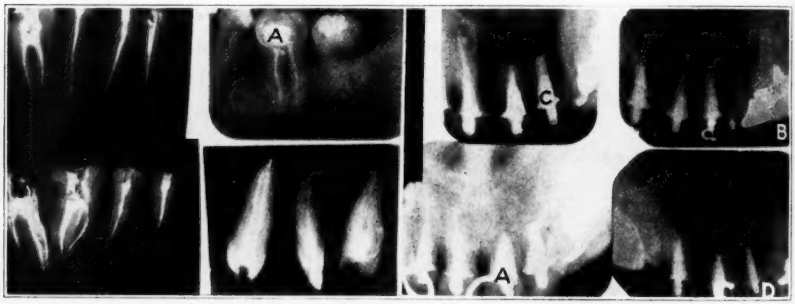


Fig. 11.—(A) Cultured eighteen years after treatment for abscess and found sterile.

should never be left in the tooth for more than a few hours.

The object of this procedure is to reduce the baterial flora of the outer portion of the pulp chamber and consequently make the milder antiseptic chloramine more efficient in the apical end of the canal. A 1 per cent solution of chloramine is used. The first dressings of the latter drug are sealed in with temporary stopping by the method previously described and never left for more than twenty-four hours, when the dressing is removed and cultured. Usually the first two or three dressings will be found infected. Treatments are changed daily until one or two negatives appear. Then the treatment is allowed to remain without change for three or four days and if still found negative, the experiments are carried out farther by sealing in a sterile cotton or paper point saturated with culture media. This is left in for from two to four days, then removed and another treatment of chloramine introduced and time enough given to see if the culture media has become infected. If the latter has remained sterile, we have considered the tooth ready for the filling material. A study for a suitable material is in progress at this time. Of all cases studied, only two have been met with that have not yielded to the treatment. While these cases ceased to be painful after a few treatments, we have been unable to get two consecutive negative cultures as yet, after more than twice the usual number of treatments. All dressings left for twenty-four hours become saturated with cystic fluid and the patient's resistance is such that there is little or no combating power from within and the very method of treatment that has seemingly proved successful in all other cases appears hopeless. The interesting feature of these cases is that they were brother and sister; the latter presented with both upper laterals infected that failed to respond as should have been the case. A blood count revealed a 33 per cent shortage of red cells, high in total whites, but low in polymorphonuclear cells. Before all these facts were before us, we resorted to root resection of one of the laterals. The healing was very slow and the prognosis is very unfavorable. More time will be required to determine results definitely. The findings will be of especial interest to us because the root amputation was carried out by the sil-



12 13

Figs. 12 and 13.—Fig. 12, A, mesial root treated and filled with reduced silver the distal with guttapercha. All the others were filled with reduced silver only. Fig. 13, teeth treated and resected with reduced silver: A, original condition; B, after treatment and resection; C, eighteen months later; D, three years later.

ver technic. These cases demonstrate clearly the necessity for closer study of the patient before undertaking root-canal treatment. We have experienced clinically several other families where there was no response to treatment. These cases were not cultured and do not belong in this report and are only mentioned here because of the related interest.

The second part of the question then presents itself, How long will well-treated pulpless teeth remain aseptic?

Fig. 14.—A quack dentist's Klondike. A sure path to arthritis. The patient suffered four years with rheumatism. Permanent recovery after extraction.

This can only be answered in a general way, for we have not had the opportunity of culturing teeth treated by either chloramine or chlorine by electro-sterilization. The illustrations show cases that have been treated by others and by other methods that have been found aseptic many years after, demonstrating that in certain cases, at least, treatment is possible.

The question has often been asked, Are granulomas infected? This would be difficult to answer because the term has been so warped that it may mean anything from a chronic alveolar abscess to a cicatrix. True granulomas as we use the term have been found sterile in most cases but a few cases cultured have proved otherwise. All granulomas where the whole tissue was introduced into the medias were positive. These were contaminations. It is very difficult to aseptically remove a granuloma. They should be removed as carefully as possible and then material taken from within with sterile glass pipettes, just as one does in taking a postmortem culture from a kidney or a spleen.

Conclusions

This work has just been well begun. It is far from being flawless, but our efforts thus far have proved to us at least that to say that all pulpless teeth are infected in six months after pulp removal would be far from the truth. So pernicious a falsehood published in the name of science should not stand unchallenged. That infected teeth have been treated with encouraging results is admitted, but that it is wisdom for the profession-at-large to undertake such treatment, must likewise be admitted. A member of our profession has well said that there are still chapters to be written before this momentous problem will be satisfactorily settled.

In conclusion, we wish to thank the Michigan State Dental Society for their most generous support toward the experimental end of the work.

By CHALMERS J. LYONS, D.D.S., Ann Arbor, Michigan

We will acknowledge that during the last decade probably the greatest advances that have been made in the medical science have been in the development of knowledge of the role which infection in one part of the body plays in the etiology of disease in other parts. There is no subject during the last decade that so much has been written about as the subject of focal infection, Literally there have been volumes written on this subject.

The fact that there has been so much written about this subject and so much written that was misleading to the younger men in the profession, induced

Dr. Rickert and me a few years ago to take this matter up to see if we could not properly evaluate some of this literature. As a result of that we find that a great deal of this writing has been, as we have proved to ourselves both in a clinical way and a laboratory way, unscientific. Yet we are charitable enough to say that much of this writing has been honest, much has been written on the subject of focal infection that has been taken from radiographic evidence alone, and from unscientific bacteriological findings.

Radiographic evidence is not sufficient for us to properly evaluate this great subject of infection. When we look at a dental film we may see a rarefied area. This rarefied area may be traumatic, it may be anatomic, it may be pathologic. Yet the great majority of dentists when they seen a rarefied area around a tooth say at once it is pathologic.

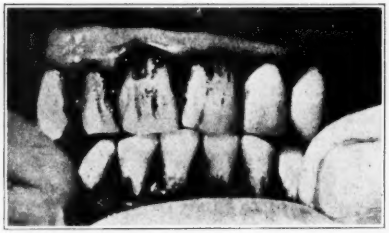


Fig. 1.—Bacterial flora at gingival margin of a tooth.

Two years ago we felt that we would go a step farther than radiographic evidence in this work. We therefore tried to work out a technic by which we could ascertain in a scientific manner whether all the rarefied areas that the roentgenogram shows are infected. Much of the evidence that has been published in the past has been obtained by extracting the tooth and then culturing the root end.

Figure 1 shows the bacterial flora at the gingival margin of a tooth. Figure 2 shows a smear taken from that region under magnification. This whole area is teeming with micro-organisms, some of which are pathogenic and others are non-pathogenic. With our present methods of sterilizing our operative field in the mouth it seems utterly impossible to sterilize this field so that a tooth can be extracted thru it and not become contaminated. Yet this procedure is what is being done and the results are being published, which shows that all of the pulpless teeth are infected. As a matter of fact some of them are infected during the process of extracting by coming in contact with the mouth flora. Dr. Rickert and I felt that this technic was far from being sound and if we were to get at the truth of the matter as to the status of pulpless teeth a different technic must be obtained.

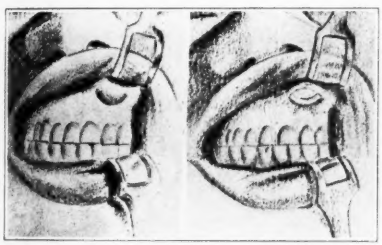
Fig. 2.—Smear taken from gingival region, under magnification.

The technic which we have employed in this work which has led up to this report is still crude and we feel that it can be improved upon.

Our objective is the apical end of the root. This is where we expect to find the infection if there is any. Instead of taking the chances of the root end becoming contaminated in the process

of extracting we have gone thru the mucoperiosteum and alveolar process directly to the foot end and cultured the rarefied area and obtained the results.

The technic which we are using is as follows: The lips are retracted (Fig. 3) and the gum tissue is dried with alcohol. Then a 7 per cent solution of tincture of iodin is swabbed over the surface and left for three minutes; this is then removed with alcohol and then an incision is made directly over the end of the root which we wish to culture. The mucoperiosteum is laid back exposing the alveolar process overlying the root



3 4

Figs. 3 and 4.—Fig. 3, lips retracted. Fig. 4, mucoperiosteum is laid back exposing aveolar process overlying root end.

end (Fig. 4). Then with a sterile surgical drill (Fig. 5), an opening is made directly over the end of the root. A small spoon-shaped curette is then used to stir up the tissue over the end of the root and culture material obtained. With this technic we feel that we have reduced to the minimum the possibility of contamination of the culture and hope as time goes to improve on this technic.

You may wonder from these reports why we do not bring to you something that you can take home and use in your practice. The subject of infection is a very intangible one. This present generation may not live to see the day when we will know all about the subject of infection. Our clinical evidence, backed up by laboratory experiments, has convinced us all that we are not yet ready to condemn all pulpless teeth, but we do wish to condemn, in the strongest terms the method by which these teeth were made pulpless. If the dental profession several years ago had taken this stand we would be far ahead today.

One of the greatest fields today in dentistry is to get some practical means by which the root canals may be sterilized in a simple manner. We know at the University that we can sterilize a root

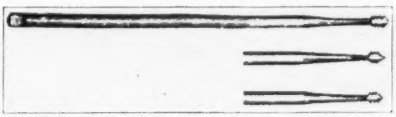


Fig. 5.—Sterile surgical drill.

canal. We know that it can be sterilized by the reduction of silver, yet there are several features about the reduction of silver that are not satisfactory. The possibility of discoloration of the tooth is one of them. Recently we began some experimental work on the anilin dyes. There is a possibility with the anilin dyes that some simple method may be worked out by which every dentist may be able to sterilize these canals in his office. I am simply mentioning this as a possibility. Instead of condemning pulpless teeth, let us condemn the methods, and then get busy on some method by which these teeth can be sterilized. Unless we do so the foundation upon which conservative dentistry has been built is going to fall.

STUDIES OF DIET IN RELATION TO HEALTH

By E. V. McCOLLUM, Ph.D., Baltimore, Maryland

(Read before the Chicago Dental Society, January 19-21, 1922)

IT HAS been my good fortune during the last five or six years to come in contact with specialists in a number of fields of scientific medicine and other branches of learning. This contact, I believe, has given me the right to discuss a subject which at first thought may seem to be on a parity with the various other phases of dentistry which have been presented by others.

There are many who believe that the fight on tuberculosis is a specific and definite health problem. I have come to believe that there is no problem, such as tuberculosis, which can be divorced from other health factors. In so far as we have progressed in the last century to an appreciation of the role which infected milk may play in the infection of infants with tuberculosis, bovine tuberculosis, and in so far as we educate people not to be afraid of the night air, just so far we will reduce steadily the progress of tuberculosis and its ravages.

We have great activity in the direction of the control of malaria, in the control of hookworm disease and the eradication of yellow fever. These are considered public health problems. Is the problem we are considering a public health one? I believe not. Because it fails to strike at the most fundamental consideration, namely, the building of a strong vigorous body with its own barriers of defense, and these, after all, are the greatest protection we have. It is then with this history that I want to present to you experiences which I have had in my own limited field of experimentation, and I shall do so just as briefly as possible, and then illustrate a few specific types of malnutrition and show their relation to diet.

First, I want to present the more technical aspects of the subject of diet, then show how we have progressed to an exact knowledge of the specific properties of our more important natural foods; then to an understanding of a group of diseases called deficiency diseases which are so striking and spectacular as to detract attention from the most fundamental considerations in nutrition; then to correlate the value of studies now fairly extensive of human experiences with diets of different types, and in different parts of the world with the health conditions of the several groups of people whom I shall discuss.

We learned about twelve years ago that a chemical analysis gives no indication whatever of the nutritive value of foods. That is a most surprising thing, but we now have no confidence whatever in the results of chemical analysis as an index of the physiological properties of foods. There is but one way to discover these facts, and that is thru the results of the taking of diets of peculiar and restricted types as applied to animals and man.

When we come to appreciate, as we did about the year 1914, that a diet in order to be satisfactory must contain the following list of substances, we realized we had taken a step in advance which forms the foundation of what I believe to be the most important feature of public health. A diet, in order to be satisfactory, must contain an adequate amount of such substances as proteins, examples of which are white of egg, the

principal components of meats, etc. The values of these things are vastly different. There are different nutritive values of proteins thru different sources. There are great differences in quality. So we must have not only an adequate amount of proteins but proteins of suitable quality. Furthermore, we must have the source of the sugar and glucose, and they may be in the form of starches or in the form of sugar, as milk sugar, cane sugar, or glucose itself. We must have nine inorganic elements—sodium, potassium, magnesium, chlorine, iodin, phosphorus, sulphur and iron. Of the nine elements, eight can be furnished to the body in the form of mineral salts of suitable composition. Sulphur can be furnished to the body in utilizable form only in an organic substance, which is one of the digestive products of protein which is called cystin. We must have in the nutrition of man three or four substances of a chemical nature. We may need only two, but we need three substances, as we know what happens when one or another of them is omitted from the diet. These three are collectively known as vitamines. When one or another of these is left out of the diet there results a specific syndrome which is striking in character. One of the vitamines is now generally spoken of as vitamine A which is abundant only in a few natural foods, and it is associated only with certain fats, butter fat, egg fat, cod liver oil; fats from the liver, kidney and pancreas of animals contain more or less of these substances. The vegetable oils and fats contain demonstrable amounts of it. The diet may be satisfactory so far as other factors are concerned, but if vitamine A is left out of the diet there is invariably produced a specific condition, the most striking characteristic of which is an affection of the eyes, a type of ophthalmia. Within a few weeks of specific starvation with this substance the eyelids become puffy, and then an exudate appears in the eyes; a yellow spot appears in the colored portion of the eye, owing to the fact that the white blood corpuscles find their way into the chamber of the eye. Ulcers form on the cornea. The progress of the disease is striking if puffiness of the eyes is seen, and in the course of a few days the eyeball perforates unless proper remedial agents are administered. The animal becomes infected, and death quickly supervenes. We can take an animal in the last extremity of this peculiar deficiency disease, give him a suitable amount of cod liver oil, butter fat, or egg, liver or kidney, and day by day we can see an improvement. Within two or three weeks the eyes have returned to normal, the edema of the lids has disappeared, the inflammation has disappeared, and the animal appears normal again. If we leave this protective fat out of the diet the animal goes back into the same condition and can again be snatched from death's door by the administration of fats containing these peculiar dietary properties, namely, a suitable content of vitamine A.

There is another deficiency disease known as beriberi. It used to be taught that it is a tropical disease, but it is not common in Labrador. It occasionally occurs in this country. It is a type of general paralysis known as beriberi, or when we produce it experimentally in animals it is known as polyneuritis. There was an outbreak of this disease in Elizabeth, New Jersey, in July, 1914. They went to the extreme at the time in feeding prisoners on highly milled cereal products, degerminated corn meal, polished rice, and rolled oats. This disease has taken millions of lives in the course of the years. It is so spectacular as to detract from the milder forms of malnutrition.

There is another deficiency disease long known. It has been the scourge of armies, the scourge of prisoners, and the scourge of sailors at different times

in history, but it almost disappeared during the last half of the nineteenth century. This disease is known as scurvy. Scurvy was at one time a disease of armies. Later, after the discovery of America, with long sailing voyages, it became a disease of sailors. It was the customary practice of the masters of sailing ships to administer lime juice or lemon juice on fresh vegetables, and this led to an outbreak of scurvy among the sailors. The greatest factor in its eradication was the advent of steam navigation, which shortens the voyages. The sailors had a new type of diet, so that now we have come to regard scurvy as a disease of the past. Curiously enough, in the last part of the nineteenth century there frequently appeared among infants a disease or condition so important as to constitute a new menace to health. There is an interesting story in connection with that. It came about by the pasteurization of milk. The vitamine which protects against scurvy is a very unstable agent. Heat or drying from air for a considerable period of time destroys its antiscorbutic properties. Frequently in the past the health officers of cities have traced epidemics of typhoid, scarlet fever, or sore throat to the milk route, so that certain diseases were frequently referred to as milk-borne diseases, and Pasteur, a famous French chemist, about 1875 pointed out that if we heat milk for thirty minutes at a temperature of 145° F. it would render it safe from the transmission of this disease. That process became known as pasteurization and was so efficacious that health officers acclaimed it as a great advance in public health. The progressive cities of the world began to adopt the pasteurization of milk supplies, and what has been a blessing to the adult population was in disguise a calamity in the lives of a great many infants because infants who were fed exclusively on pasteurized milk developed scurvy. There was not much literature on the subject of scurvy in infants. That was a new thing. It remained for Sir Thomas Barlow, a famous Englishman, after 1890, to describe a disease which is still known as Barlow's disease, which is a complication of rickets and scurvy. We now know that in infant food, such as heated milk, there must be put into it a little fresh orange juice, a little fresh cabbage, a little fresh tomato juice, which will put back into the heated milk the property it has lost. This leads to nearly the disappearance of infant scurvy, altho we have one or two or three cases of infantile scurvy almost always on hand in the hospital at the Johns Hopkins University. These are spectacular things. They are deficiency diseases that have attracted attention. People, particularly in the Far East, are concerned with the modification of the diet of the orientals so far as to protect them against beriberi, but they are not taking a broad view of the subject of nutrition. In the aggregate, the most important thing about malnutrition is the existence of what is known as borderline malnutrition — malnutrition of a degree which is scarcely recognized or not recognized at all; a malnutrition of the type which lowers the efficiency of the individual, which breaks down his barriers of defense against infection with micro-organisms, which leads to a much more rapid decay of the organism than would otherwise result.

Following the working hypothesis as to what constitutes a satisfactory diet, in various laboratories in this country and in England, for a period of four or five years, we have seen great activity in the application of what has been called the biologic method for the analysis of foodstuffs. This method I described in 1915, namely, a systematic series of properly planned feeding experiments with an individual food which is deficient in one or another respect and supplemented with two or three purified food substances to discover wherein lies the deficiency. We

have seen the application of this method for some years and now have a bit of useful knowledge about the specific properties and specific shortcomings of our natural foods.

We have proceeded with a series of studies which led us to the following generalization. The first generalization is that it does not matter what the chemical composition of a diet may be; it does not matter what variety of foodstuffs it may contain, nor how the menus may be changed from day to day; so long as the food supply is derived from the list of foodstuffs, failure of nutrition will not supervene.

One may have in the diet whole wheat, corn, rolled oats, barley, rye, peas and beans, potatoes, sweet beets, radishes, turnips, beets, and carrots. We may put in with these cuts of meat which we have designated muscle cuts of meat, ham, steaks, and roasts. These all combined or in any combination, irrespective of variety or composition, will lead to failure. Young animals of any species put on such a diet will not remain alive long. I am condemning before you foodstuffs long recognized as wholesome, that have long entered into our diet. The first question I am raising is that cereals have always been our stable foods. There are but three types of diet which offer certainly any nutrition for man or animal, and only three will ever succeed. These are, first, a strictly carnivorous diet. We have as examples the lion, the tiger, the wolf, among animals; the owl and vulture among birds. As to their type of meat eating, they consume all parts of the animal while we imitate this type of carnivorous nutrition. In the laboratory we succeed just as well with them as animals on this type of diet.

One can do serious damage to any animal from time to time, taking animal experimentation as a background for the interpretation of human problems, by restricting an animal to such a meat diet alone, such as steak, ham, or other muscle types of meats.

The second type of diet which in animal experience succeeds is that of the grazing type. We have examples in such an animal as the bison which lives generation after generation on small amounts of buffalo grass. It eats the leaves of plants and succeeds in large degree in building up its nutrition. There are places now in California and in Arizona where cattle are kept from generation to generation exclusively on alfalfa plant, and while they are not nourished in optimal fashion, they succeed very well as commercial ventures. There is then a type of leaf eating which is successful in building up nutrition.

Considering the history of human diet, there is a type of oriental diet which is the third one which I want to bring before you. This type of oriental diet has a fair measure of success, but it is not so successful as certain other diets may be, namely, a diet which in many respects is like our own. In the north of China it consists of whole wheat, of millet seed, of more or less pork, eggs, poultry, and small amounts of various other things, but the outstanding feature of the diet is the consumption of green leaf vegetables. The first man to call attention to this was Albert H. Bailey, director of the Experiment Station at Cornell University, who is very familiar with China. Since that time I have had opportunity to learn from medical observers, from nurses, from the Chinese and Japanese and from foreign students more in detail about the features of the oriental diet. The outstanding feature is the quantity of green vegetables which they consume. When we imitate that diet of a mixture of leaves and seeds we succeed with carnivorous or herbivorous animals to an equal extent. This type of diet succeeds. The importance of putting into the oriental diet large quantities of leafy vegetables which they consume is the feature of the diet that

has kept these people from extinction, but they do not live so long nor are they so well developed physically, nor are they so aggressive as our people who have other dietary habits. This then to me characterizes the oriental type of diet.

Another type of diet which I want to speak of preliminary to our present-day problem in nutrition is the one which our ancestors lived upon. I am going to repeat a phrase that conveys an idea which I believe is a very fundamental one, and which appears to be new to everyone, namely, that in those parts of the world wherever we may now go we can discover an area of considerable extent where it does not pay to farm. There we find health conditions with respect to physical development decidedly better than we find them in those regions where is does pay to farm. For example, our ancestors originally came from Asia, Europe and America, and they placed their reliance from Europe on the Bible in the latest phases of human history. Their hordes came out of Asia. There is a vast region in Asia where it does not pay to farm. Those people are nomads who wander about where there is pasturage and they live exclusively on the products they have there. Cattle, sheep, goats, horses and camels constitute their products. They live on a carnivorous diet. Sour milk constitutes the principal article of their diet, and the second one is that of meat. They add certain small amounts of vegetable food to the diet, but it is not a general carnivorous diet. All these people are exceptionally successful in physical development.

We as a people in the last one hundred years have made changes in our dietary habits which are of fundamental importance. We have tried a new experiment in nutrition, and it is an experiment which in the long run is a failure—the introduction of large amounts of cereal products into our diet. We may say that cereals have always been principal foods. The cultivation of cereals on a large scale is a new thing.

The first cereal grown on a large scale was rice because it did not have to compete with grass. We have, during the last century, since we have entered with great vim and vigor into the industrial age, the age of invention, introduced a new type of diet. We have changed from a rural to an urban population. We have seen the invention of the effective steel plow which can turn over effectively the sod and turn it over as often as necessary to kill out the grass. We have effective reaping and thrashing machinery. Still infection of the mouth and decay of the teeth go on thru our food supply. We are taking vast quantities of cereal products never before used in human experience. We can discover the effects in two ways. One is the source of animals by restricting such a diet, and the other is human experience based on similar types of diet.

There is another factor which has entered into the problem during the last fifty years, which is perhaps of equal magnitude to the introduction of cereals. We would be much better today if we could consume whole wheat, whole corn and unpolished rice than we are by eating the leafy products of these grains. I refer to the corn milling industry. Fifty years ago this industry in this country was localized. The wheat was taken to the local mill and ground between two little stones, and whole wheat flour would be taken home and used in the mouth. Whole wheat flour is not satisfactory to market. It harbors insects and the commercial man does not want to handle it. For that reason we have seen the production of mills for cereal products, both of wheat flour and polished rice. These milled products are furnished to us for breakfast foods. We have been using more and more cereals in our diet. We have used and are using highly milled cereal products. It is a strain on us. We have found out

for some time the part these cereals play in the process of physical deterioration.

In the National Museum at Washington there are series of something like four hundred skulls of Indians from Alaska, the Pacific Coast, Central America and Peru dating from about Columbian times, varying in age from three hundred to five hundred years. These skulls exhibit no indication of decay of the teeth. The teeth are well developed; the jaws are well developed. The teeth are not even worn badly. Occasionally you will see a mechanical injury but no decay.

In contrast to that we are told by such men as Dr. Clark of the Public Health Service in Washington, who has examined thousands and thousands of school children in different parts of the country, that 90 per cent or more of the school children in this country have from one to eleven cavities in their teeth. We also learn from experience with school children that the number of bad teeth very pretty nearly parallels the other signs of physical inferiority. In so far as you find flat jaws, deformed chests, immobile jaws; in so far as you find a fatigued posture and fatigued expression on the face, the tendency to anemia, and indolent habit of mind and body, flat feet, bow legs, and knock-knees—these imperfections go with a high percentage of tooth decay. We have other illustrations of this. Take, for instance, the islands of Iceland. Iceland was settled in the ninth century by colonists from Ireland and Scandinavia. The people lived there in a region where it does not pay to farm. They took with them cattle, sheep, horses, but no poultry, and for a hundred years they have lived practically on a carnivorous diet. Milk, mutton, fish, birds' eggs, and wild fowl constituted their diet. While they subsisted on that diet they were excellent specimens of physical development, but in the last seventy-five years they have been steadily progressing into a state of physical deterioration. Mr. Stevenson, the Arctic explorer, speaks of ninety-six skulls in the Icelandic region being on exhibition in a museum, these skulls dating from the ninth century, and in these ninety-six skulls there were no definite evidences of tooth decay, except one tooth which was badly broken from mechanical injury. The Icelanders of the present generation are suffering from skeletal deterioration and from tooth decay. This can be correlated with the introduction of commercial contacts of the people of Iceland with those of other parts of the world. More and more they have in recent decades sold the products of the sea and of the land and have introduced more and more cereal products from other parts of the world. They have come more and more to use the type of diet on which we subsist, namely, grocery store stock in this country. With that comes physical deterioration.

The American Indian is another example. Dr. Clark and others testify that the Indians in many cases in their primitive state were magnificent specimens of physical development. On the reservations of Wisconsin, Minnesota, Montana, etc., are Indians of middle life with pretty good sets of teeth, but the younger generation are in a much worse condition, because the non-satisfied Indians have been worrying the government of the United States to provide for them their means of sustenance. They have subsisted on the products of grocery stores, and have not only come in contact with civilization, but have come in contact with muscle meats, milled cereals and potatoes, a type of diet which constitutes our national dietetic sin at the present time. That type of diet is a failure in animal nutrition, and it is a failure in human experience.

During the war the problem of rickets, of skeletal defects, of faulty bone growth became so important in England and Scotland that the British govern-

ment had an investigation made by the Medical Research Committee of Great Britain which consisted of eminent physicians, eminent physiological chemists, and physiologists. These people published an extensive bulletin on the subject of rickets about three years ago, and their findings were that in the environs of London, Glasgow, and Edinburgh, no less than 40, 70, or 80 per cent of the children of England and Scotland had or did have rickets. It is a national health problem of great proportions.

In 1921 Alfred F. Hess, a well-known pediatrician of New York, wrote an article on rickets in which he stated in his preliminary remarks that all are agreed that no less than 50 per cent of the children of the working classes in this country at the present time either have rickets or have had it. Rickets is a disease of bone, of faulty bone development.

There are some striking things in connection with rickets when we study it carefully. In the first place, it is confined in great measure to the North Temperate Zone and is a condition of Europe and North America. There is an interesting contrast between conditions in the Island of Lewis in the Hebrides and in the west coast of Scotland in Scotland itself. In Scotland rickets is quite prevalent everywhere. People live in houses that are pretty well ventilated; they eat the ordinary food products of the grocery store. They eat white flour, corn meal, etc., altho they do not use so much of it today. They eat more muscle cuts of meat, tubers, and the like, which form staple articles of diet, and the children suffer from rickets.

The teeth of people in Scotland and in England are in a worse condition than are the teeth of Americans. In the Island of Lewis in the Hebrides there is a group of people of Scotch origin who live under primitive conditions They illustrate a human experiment of the greatest interest in connection with the problem we are now considering. They live under miserably poor conditions. The climate is unsuitable to agriculture, but they grow successfully turnips and potatoes. They subsist largely on fish.

Babies in the Island of Lewis are rarely taken out of the house during the first year of life except for a few minutes at a time because their mothers are overworked. They have no time to devote to their infants. These infants spend their lives in a black atmosphere. Their eyes become inflamed. According to the Carnegie United Kingdom report published in 1912, most of the children in Scotland living on islands lower than the Island of Lewis, suffered more. Notwithstanding the indescribably bad hygienic conditions, they get a low death rate and rickets is unknown in the Island of Lewis.

There is another parallel quite striking. All over England we find instances of rickets. In the west of Ireland, where it does not pay to farm, they have no rickets. It means primarily this: We have gradually changed our diet during the last half or three-quarters of a century to a type which was new in human experience, and that experience is one that has led us to a condition where 20 per cent or 30 per cent of the public school children are found to be underweight in a marked degree; where they have all the signs of malnutrition; where 30 per cent or more of the young men were found unfit for military service, and where tooth decay is second in importance as a cause of rejection for military service.

The most fundamental thing we can consider is the building of a vigorous constitution. As a profession we have ignored the developmental factor as the one that is operative in preventive dentistry. If we are going to have individuals to live normal lives, we must have normal development. The things which we must do to bring that about are the

correction of the faults in the diet which we have gradually drifted into.

About four years ago Miss Simmonds, who works with me, and I decided that we could properly attempt to duplicate human experience with different types of diet in the population of domestic rats. We have a colony of something like two thousand domestic rats, and we have everything at our disposal for the purpose of animal experimentation.

We have the omnivorous type of animal with a three-year span of life. These animals cannot be made to live beyond three years, and probably 75 per cent of all rats under the best conditions of nutrition and hygienic surroundings will die at the age of two years. We have duplicated human experiences with different types of diets and have conducted a large number of experiments, the results of which form a striking parallel to human experience. For instance, let us take a diet consisting of one-half of whole cereals, peas and beans and beefsteak; whole wheat, rolled oats, corn, rice, and potatoes. The other half of the diet we will make of milled cereal products, wheat flour, stored corn meal and polished rice. An animal cannot grow nor remain alive many weeks on that diet. If we proceed in a series of experiments to supplement that diet and make good its deficiencies which are, I may say, poor quality of proteins, lack of calcium, lack of phosphorus, or lack of all three of the recognized vitamines, and endeavor to improve its quality, we would observe spectacular things. We can supplement such a diet and make it capable of inducing half-normal growth of a certain period, but when the animals have reached half the adult size and cease to grow, they rapidly deteriorate within two months. We can improve the diet and they will grow two-thirds or over the normal rate and reach over adult size and look normal while growing up. At the point where they cease to grow they begin to deteriorate rapidly. They show signs of thinness of hair, lack of luster, unevenness in the length of the hair, and an irritable nervous system. The normal rat has a characteristic attitude just as a normal human being has one. It is one when once seen or pointed out can be easily recognized. It is an index of its outlook on life just as the appearance and expression of the face of a man are an index to his outlook on life. A well-nourished rat has a stable nervous system. He has no apprehension of danger. He does not mind being handled, but those rats suffering from malnutrition from one cause or another show an abnormal behavior. In hundreds of rats put on diets in which protein only is at fault, inadequate in its quality or amount, the mothers show infanticidal tendencies and destroy their young invariably within the first day or two after birth. Not infrequently we have seen six dozen female rats growing on a diet which is faulty in respect to protein, borderline cases of malnutrition. They are capable of reproduction. Where there are six dozen rats there will be three litters of rats, and the mothers will destroy every one of them. Where we change the diet to improve the quality of protein, the one factor which is at fault, and we proceed with three more litters, the female rats will rear 100 per cent of their young. The correction of that one fault in the diet has changed them from an abnormal psychic reaction or disturbance to one of the most fundamental attributes of the nervous system, the reaction of the mothers toward their young, and put them into a perfectly normal attitude. On the other hand, if the diet is too poor in calcium and has no other fault, they exhibit very different characteristics. They will not grow under such circumstances but remain stunted. If we try to catch an experimental rat which is undernourished, suffers from lack of sleep, shows no interest in his surroundings because his system is wholly upset on account

of the absence of calcium in his dietary, he has apprehension of danger, and if we attempt to capture him he will fall on the floor and may be attempt to kill himself. He may so strive to get away as to make it almost impossible to catch him. The way to find out whether he has gained or lost in weight is to correct the fault in that diet. Precipitated chalk in proper amount which carries calcium should be put in, and in three or four weeks the rat can be exhibited for ten seconds with no apprehension or fear of danger.

We have in the last two years and a half made a very careful study of the cause of rickets. In order to do that we took four of the principal basal food mixtures consisting in great measure of cereal greens, but in one case with potato put in, and in another case beefsteak, and in still another case peas and beans, all of which diets produce inferior skeletal development. We have modified these basal diets four hundred and fifty ways, and each of these groups has been studied microscopically and histologically. The bones have been carefully observed, and we now have merely a complete demonstration as to the cause of rickets. It is largely due to a disturbance in the ratio between calcium and phosphorus in the diet. It is in this connection that we have demonstrated the existence of a new and fourth vitamine. Whenever calcium and phosphorus are kept low and subminimal in amount, and we adhered to the proper proportion between them, we did relatively much less damage to the animal than we if disturbed the proper ratio between calcium and phosphorus. With calcium too low or phosphorus excessive in amount we produced rickets. If we give such an animal cod liver oil, we will protect him in a marked degree against the effects of this disturbance by the mineral salts in the diet. We cannot do that with butter fats or other fats which are effective in this peculiar disease, but there is a new property here. The leaves of plants have the same property in a rather pronounced degree that we find in cod liver oil, which is a protection against rickets.

All this leads us to the final conclusion that we must modify our national diet in some way to overcome the defects that now exist. We have accumulated a considerable number of histories of mothers who have nursed their infants and whose infants have developed rickets while being nursed. These mothers have lived essentially on a diet of milled cereals, beefsteak and potatoes. Such a diet is unfit for the production of an adequate milk supply, and it is in great measure due to this type of diet that we have rickets occurring so frequently at the present time.

The most important things we can do are very few in number. Any plan we put before the American public must be one to establish dietary habits in marked degree. One thing we wish for is the discontinuance of large amounts of sugar. We do not need much, if any, sugar, for our physiological well-being. We would be distinctly better off if we did not take any sugar, but that does not mean we should not take a certain amount. A small amount would not do any damage. In the last century we used from ten to fifteen pounds of sugar per person per year. During the first half of the year 1921 statistics show that we used from fourteen to fifteen pounds per person. As a people we consume excessive amounts of cane sugar. Cane sugar is one food which we take in a form which is soluble in water, but the proteins of fats and of starches when taken are insoluble. We digest these things in ordinary fashion for a period of some hours. They never accumulate in large quantities in the intestine and stomach. When we load the alimentary tract with sugar we have an osmotic pressure capable of immediate absorption. Overloading the body with sugar does damage in greater or less degree by crowding out of the diet

certain other things which would be more wholesome, so that the consumption of sugar is one of the banes of our existence at the present time.

One of the things we can do is to bring about a large reduction in the consumption of sugar which will immediately improve our physical condition and start us back toward a condition of better physical perfection than now exists. First of all, I would say that by far the best feature in the oriental diet is the consumption of salad dishes and such things as the greens or fodder. We need a certain amount of raw food of vegetable origin to provide an anti-scorbutic vitamine. If we take a salad consisting of raw cabbage, celery, raw fruits, nuts, and the like, which we know is appetizing, we know we have a diet which will correct the defects in the meat diet, and also correct the mineral effects and vitamine effects. If we take an article of diet which encourages chewing, which is almost a lost art among us, and one of the things which we need, by introducing some form of salad twice every day, we can do much toward our well-being.

A second thing of importance is to consume liberally—at least once a day—some article, such as cabbage or spinach, or Brussels sprouts, or turnip tops, or dandelions, or some other article of the leafy vegetables which we have classed as greens or fodder. This dietary is such as will correct in great measure the defects of milled cereals and the meat type of diet.

A third thing in importance in connection with our dietary is to see that it does not lead to a disturbance of our dietary habits, as the introduction of very liberal amounts of dairy products into it, milk and its products. These things, simple as they are, prosaic as this proposition may seem rest upon a sound basis of animal experimentation which correlates with human experience the world over, and it is the wisest policy we can adopt, and it is the most fundamental consideration in preventive dentistry. If we are going to have good teeth we must first develop good teeth.

In this elaborate study of the effects of diet on bone growth we have had the co-operation of Dr. Grieves, of Baltimore, who has examined the teeth and skulls of about thirteen hundred experimental animals, representing a wide range of modified diet. In that series of skulls we often duplicated lesions of human dental defects. We are now in process of correlating the type of dental defect in so far as that can be done with the specific fault in the diet, and there are some striking things in connection with it. All these animals live in the same room, have the same sunlight, and same temperature, the same ventilation, the same opportunity for exercise, and diet is the one variable factor, and with that one modification in their lives we have produced in certain cases a magnificent dental apparatus which will last thruout life. In other cases we have produced pulp exposures in the incisor cavities and in molars. We have produced abscesses in the apices of the teeth from faulty nutrition. There is one way back to better physical development, and that is the most fundamental of all, namely, to build up a normal and physical structure, and that can be done only thru proper diet. The child of school age is beyond the reach of help in this respect. His teeth are already formed. This preventive dentistry proposition is largely one of prenatal life and infancy, and we must learn to analyze it. Perhaps there is no more important branch of medicine than pediatrics, and in this department of medical practice we see a high incidence of rickets, the frequent occurrence of scurvy and the occurrence of malnutrition. We must learn to guard against these defects now. Knowledge is now available by which that can be done, and we can proceed with our eyes open and with the definite assurance that the results we desire will follow.

Discussion

[At the close of Dr. McCollum's lecture, the following questions were asked by dentists and physicians and the answers given by Dr. McCollum].

Q. What effect does cooking have on the vitamine content of cereal C?

A. One of the vitamines concerned with the development of polyneuritis or general paralysis is not injured in a demonstrable degree by ordinary heat or by such temperatures as are used in the sterilization of canned goods. The fat-soluble vitamine is not injured by heat in the common ordinary condition of cooking, but is rapidly destroyed when heated in the presence of air. Oxidation destroys it. High temperature alone does not tend much to destroy it. The anti-scorbutic vitamine is rapidly destroyed by heat.

Q. Is there any influence in cooking on the uric acid forming properties of meats? Physiologically, it was expressed sometime ago that meat, when it is cooked more than it should be cooked, has too much urates.

A. There is not much in the uric acid forming properties of meats when cooked under normal conditions.

Q. What do you think of the present practice of commercial houses putting out vitamine tablets and selling them to the public at large?

A. Whether these vitamine tablets are sold for self-medication or for administration by the medical profession as therapeutic agents, it is one of the most reprehensible practices which has been foisted on the American public in recent times. There is no place, no legitimate place, for this class of substances whatever. The only satisfactory way to secure a supply of vitamines is by a properly planned method and the selection of such foods as I have recommended to you here. If you take these foods you will have at least three or four times the minimal amount of one of the common vitamines or all three of them as would be necessary for normal development in the young. It is possible to get a liberal supply of these substances in a properly selected diet. The place to get vitamines is not the market and grocery store, and not in the drug store. I have repeatedly received samples of these preparations from manufacturers asking me to analyze them and to give them my opinion in regard to their use as a part of the dietary. After looking at the labels I have been impressed with the fact that on these new labels of vitamine tablets of one kind or another we have the same old story that we have seen for so many years on the labels of patent medicines advertising cures for cancer, tuberculosis, and other diseases, and they are sold in grocery store fashion to the American public. These new things offer great possibilities to the impostor and he takes advantage of it. Education is the only way I know at the present time to deal with this situation. It is a foolhardy purpose and a waste of money to spend it on these vitamine preparations. All of them should be condemned unqualifiedly.

Q. How do you account for the fact that in a family of children one may have sound teeth and the others may have bad teeth, although the environment and diet are the same?

A. That question is difficult to answer, but the answer unquestionably may be found in something like this: the teeth are formed in great measure in prenatal life and in infancy. There are vicissitudes in both of these periods of life, and it is an easy matter either from disease or from relatively brief periods of poor handling of an infant to ruin its teeth. It is impossible to answer this question specifically unless you know of a specific case, and you cannot get the evidence in the family. Wherever defective development occurs it is due to some misfortune of the child. There are other problems which enter into it. Infectious disease is one problem; mouth hygiene is a problem, and all these should receive their proper evaluation. I am not trying to displace other important factors, but I am trying to emphasize what I believe is a most fundamental condition which should form the first point of attack in a public health problem.

Q. Is there any particular value in yeast as an article of food?

A. I am not very much convinced that it has value further than that yeast tends to grow in the intestinal tract. It tends to produce a certain amount of fermentation; it tends to produce peristalsis; is tends to facilitate elimination, and constipation is one of the very damaging things which affects a large proportion of both the adult and youthful population, and anything which tends to make a little better hygienic condition in the alimentary tract will lead to an improved feeling of well-being. Yeast promoted as it is, promoted as a source of vitamines, is fraudulently promoted. Yeast contains only one of the known vitamines, and that is the water soluble vitamine which protects against beriberi.

Q. What proportion of the diet should consist of fruit?

A. No one can lay down hard and fast rules as to what percentage of the diet should consist of any one article. It is especially difficult to say just how much fruit one should take. I should prefer to answer that question by saying we ought to eat some raw fruit every day. I am inclined to believe that

where economy is concerned in the use of foods, we should be limited to an orange or an apple a day.

Q. How about purified cod liver oil?

A. Cod liver oil emulsions contain very little cod liver oil, and sometimes none. But a high quality of cod liver oil, such as is prepared in an atmosphere of carbon dioxide so that it does not oxidize, has a rather fresh flavor and is very effective. But cod liver oil understand is not a necessity. Our needs for that particular vitamine are unusually small if we have the mineral content. Do not substitute a remedy for proper dieting. Do not take something which will enable you to compensate in a way for a faulty nutritional situation. We feed an animal a diet which is faulty in respect to its mineral content, and unless the animal has protection of some kind it develops typical rickets. Give him cod liver oil. Instead of failing to calcify the region in the end of the long bones, as he grows and develops rickets and enlargement of the bones, the animal under these conditions borrows bone substance from the shaft of his bone and succeeds in putting bone in the newly formed growing area, but he produces there a honey-combed fragile bone. It is not normal bone. We produce normal bone by having a diet properly constituted with respect to its mineral elements.

Q. In producing caries in the roots of teeth have you noticed the formation of salivary calculus on the teeth? Of course, there are teeth absolutely lacking in the mineral salts, and at the same time the salts are deposited on the outside of the teeth.

A. We have met with deposits of tartar on the teeth. We are not quite prepared to discuss in detail the relation of the faults in diet to decay of the teeth. Dr. Grieves is working along this line.

Q. What is the relation of calcium phosphate to the development of rickets?

A. Calcium and phosphorus, and not the calcium phosphate, are the principal mineral components of bones. Unless we have a sufficient amount of these substances in the diet we cannot produce bone. If we have a faulty relation between calcium and phosphorus we produce faulty bone. There is much rickets in children artifically fed, in children fed on modified milk of various kinds. We are modifying milk in a way now that is perfectly preposterous. The population is eating cream and sugars and cereals and we are ignoring one of the most fundamental factors in the development of the infant.

Q. What is the comparative value of whole wheat bread and whole rye bread?

A. There is no difference except that rye bread is harder and you have to chew more thoroly, and therefore it is to be recommended for that one thing alone.

Q. Is there any advantage in sour milk over sweet milk?

A. There is no particular advantage over raw pasteurized milk. Raw milk contains a very liberal supply of lactic acid organisms, and these continue to grow more or less in the alimentary tract. Sour milk is a good thing. The organisms of sour milk continue to grow in the intestines, especially the bacillus acidophylus. It improves the hygienic condition of the intestine. It discourages the growth of putrefactive organisms. It is good in that respect.

Q. What is the difference between wheat flour and whole wheat flour?

A. One lacks bran and the germ which the other contains. Dietetically whole wheat flour is superior with respect to dietary factors over milled flour.

Q. Is the cooking of meat for purposes of making soup healthful and beneficial to sick people?

A. Soups made by boiling meats are a stimulant to the appetite, and in that respect they are often very useful in the feeding of people with poor appetites. A soup made from meat has very little actual nutritive value. But it is a stimulant to the appetite. It more or less tends to arouse the glands or digestive juices to activity.

Q. Is it advisable in feeding children to use whole wheat instead of wheat bread?

A. It is advisable to substitute whole grain for the milled cereal product, but I question whether you can introduce that into practice widely in this country, for the reason that it takes a good deal of trouble. Any system of marketing whole wheat flour for good will involve the necessity of rapid sales, extra care, and that means extra expense in handling, and whole wheat flour has been and is more expensive than wheat flour. It is better than wheat flour. There is no good reason at all why people should not purchase whole wheat, wash it, and use it as a breakfast food. It is wholesome. It encourages chewing, a thing which we need to cultivate, and it is superior to the milled cereal breakfast food.

Q. What is the relative value of the natural and artificial form of buttermilk?

A. That demands perhaps a word of explanation. If we get pasteurized milk delivered that has been pasteurized from twenty-four to thirty-six hours before delivery, it may contain putrefactive flora which are pretty well developed. If we sour that kind of milk it is not wholesome buttermilk Buttermilk is made from fresh pasteurized milk or raw milk soured rapidly is an acceptable substance. Buttermilk made in the creamery that is clean, fresh and wholesome

is fine. But buttermilk made on farms where the cream is slovenly handled, and has undergone unwholesome decomposition is unfit to drink and deteriorates rapidly.

Q. What is the value of a vegetarian diet over a flesh food diet? I do not mean a vegetable diet consisting of green or fresh vegetables, but one in which milk and eggs are not included.

A. A strictly vegetarian diet without milk and eggs is a hazardous thing to adhere to over long periods of time. A vegetarian diet with a liberal supply of milk and eggs is one of the best diets there is.

Q. Does the cooking of most vegetables cause a deterioration in their dietary value?

A. They lose in great measure their antiscorbutic properties when cooked.

Q. Is the milk we get in the cities all pasteurized?

A. Yes, I think so.

Q. What about pasteurized milk as an article of diet?

A. It loses one property of importance only in the feeding of infants where we restrict them largely to heated milk. In these cases we must supply that one property, and when that is done it is essentially as good as fresh milk, provided it is clean and has been properly handled both in delivery and in the home. We cannot overemphasize the importance of the proper handling of milk. The thing we should do is to insist upon cleanliness in production, cleanliness and promptness in the handling. Pasteurization protects against infected milk, and there should be prompt delivery with proper refrigeration.

Q. Is not butter fat about the best we can get?

A. Butter fat, which is most appetizing, fits in with agricultural progress and with dietary habits, and it is to be highly recommended.

Q. What effect does cold storage have on the vitamine of eggs?

A. So far as I am aware, there is no effect other than probably a deterioration in the antiscorbutic properties of the yolk of eggs.

Q. What about raisin as a fruit?

A. It has a lot of protein content, rather poor in mineral content, and contains a considerable amount of sugar. Raisins are wrongly promoted as a source of iron. Raisins have nothing like the content of iron that asparagus, spinach, or beefsteak has.

Q. What about the contrast between honey and cane sugar?

A. Honey is more palatable. It is a saccharine food. It has essentially the same dietary properties as glucose and other sugars, and I am rather loath to put my stamp of approval upon the liberal use of any saccharine food, because our ideas are undergoing a change regarding this whole diet at the present time. A little of it is all right, but it should be used as a condimental food and not in quantity.

Q. What is honey chemically?

A. It is mostly glucose, but contains a mixture of fruit sugar and fruit. Levulose is fruit sugar.

Q. In a recent issue of the Journal of the American Medical Association there appeared a statement that results were accomplished with sunlight in cases of rickets, substituting it for cod liver oil. What about that?

A. It is quite true and is in accord with our experience. However, that is not an original observation, but sunlight has been written about during the last twelve years by half a dozen German clinicians, notably by Huldschinsky and others. It is true, rickets is a disease which can be prevented and helped in great measure, when it is not too severe, by exposure to the sunlight. Here we have a fine illustration of a principle in nutrition. Sunlight is a hygienic factor. Sunlight is a physical agency which tends to promote physiological processes and physiological well-being, and whenever we live under ideal conditions we are able to tolerate a fault in our diet which would in the absence of favorable hygienic surroundings lead to more severe bone defects than would otherwise occur. It is essentially comparable to cod liver oil, in that it does improve the ability of the living cells to cope with the unfavorable situation with respect to the mineral content of the diet, but it is not a substitute for a satisfactory food supply. In a measure it protects us from the over-effect of a certain type of faulty diet, but it is in no sense a substitute for faulty nutrition.

Q. When we eat the leaves of plants, what do we eat them for?

A. The inorganic content of the leaves is rich in calcium in which seeds are very poor. A cereal, such as whole wheat, rolled oats and corn, contains one-fifteenth the amount of calcium that is optimal for the development of a little rat that shows remarkable deficiency. All leaves are rich in calcium, and therefore tend to correct this marked deficiency in cereal food. The green leaves in a fresh raw condition contain three vitamines, cabbage being the poorest. In the fat-soluble ones, containing liberal amounts of both, the leaves are corrective in that respect in which the milled cereal products are faulty.

Q. In your book on diet you say that a great many minerals are found in abundance.

A. There were a number of features which Miss Simmonds kept in mind in preparing these menus, one was to relieve the housekeeper as far as possible of labor. I think the present plan which is so much fostered

by journals keeps before the American woman a never ending series of novel formulas for the preparation of foods, which is faulty. We ought not to do that. We can readily come to simplicity in the preparation of foods which will lead to the expenditure of much less human labor in this part of housekeeping without in any way leading to deterioration in the quality of the food supply.

Q. What effect has diet on goiter?

A. Goiter has been successfully treated in school girls at Akron, Ohio, by giving them liberal doses of sodium iodide thruout the year, according to Dr. Marine and Dr. Campbell, of Cleveland. Salmon and trout kept in hatcheries have long suffered from goiter and died. Some twelve or fifteen years ago David Marine, a specialist in operations for the removal or a portion of the thyroid, when asked for advice by the Bureau of Fisheries, recommended putting sodium or potassium iodide in the water, and it was found they had no trouble with goiter.

Q. Would not a modified diet make up that deficiency rather than medicine?

A. Plants and animal foods derive their iodin from the soil. It appears from quite a large number of analyses of foods available that the amount of iodin in natural foods in certain parts of the country is very small. The only way to put that article into the diet is to take more iodin occasionally, but it should not be taken except under competent advice. Iodin taken in too large quantities is detrimental.

Q. What is the value of goat's milk?

A. Its value is similar to that of cow's milk and is superior in infant feeding, for the reason that the goat does not suffer from tuberculosis as the cow does, and raw goat's milk would be safer to feed a baby than raw cow's milk.

Q. What is the relative value of oranges, grapefruit, and tomatoes?

A. Citrus fruits are essentially alike in their dietary qualities. I have heard several people say that grapefruit did not have any antiscorbutic properties. I suppose all citrus fruits have essentially the same properties. Tomato is said to be rather unique in that it contains a larger content of the fat-soluble vitamine, the one concerned in the highest production than fruits or other vegetables other than leaves, generally speaking. We should eat things in the quantity prescribed as productive foods, so much green leaves and milk in quantity, and eat anything else we wish, and select food for its palatability and the satisfaction of the appetite. We can take as much of the vegetable fats as the appetite calls for.

Q. What about oxalic acid?

A. It is a poison and should be kept out of the dietary. The only food that is likely to contain any appreciable amount of oxalic axid are the leaves of rhubarb. Rhubarb leaves should never be eaten. When war conditions prevailed a number of people ate rhubarb and get poisoned. The stalks of rhubarb contain much less oxalic acid.

Q. What about tomatoes and cabbage?

A. They contain no appreciable amount of oxalic acid.

Q. What about the value of carrots?

A. They are root vegetables which are unique in that they contain somewhat more of the fat-soluble vitamine than other root vegetables, generally speaking; otherwise they are like sweet potatoes.

Q. What about beer, wine and alcohol?

A. I do not recommend the consumption of these, but when used in great moderation alcohol does not do any appreciable damage, but it has done a great deal of damage when used indiscreetly.

Q. What about dandelion?

A. It is a leafy vegetable. It has the same properties as spinach.

Q. Does cooking affect it?

A. All cooked vegetables lose their antiscorbutic properties. We have to use raw fruits for that.

Q. What vegetable contains the most iron?

A. Spinach.

Q. What fruit has the most iron?

A. None of the fruits are rich in iron.

Q. What about mustard greens?

A. They are a palatable article and are entirely satisfactory. In experimenting with rats, overfeeding them with calcium will do damage, but any quantity of calcium we are likely to take in the human diet will probably be the optimum rather than over.

Q. What about dehydration?

A. Dehydration of fruits and vegetables is theoretically sound. Housewives do not buy them freely, and it is rather problematical whether it would succeed as an industry. Desiccated fruits and vegetables of good quality are essentially equivalent to the undesiccated or fresh article, with the exception of the sale. Dried or cooked foods lose their antiscorbutic properties.

Q. What about the use of coffee?

A. I have but one answer. For the young, coffee should be left out of the diet. It is a cerebral stimulant and should not be given to growing children.

CONTRACTIONS AND EXPANSIONS OF AMALGAMS WITH TIME[1]

By ARTHUR W. GRAY, Ph.D., Milford, Delaware

THE dimensional changes that occur during the hardening of a dental amalgam are of such importance in connection with the tooth-restoring properties of this valuable filling material that determinations of these changes are nearly always included in tests of amalgam alloys. A contracting amalgam may shrink sufficiently to admit oral fluids and bacteria between the filling and the cavity walls; an expanding amalgam may swell sufficiently to extend above the margins of the cavity, or even to split the tooth. The ideal amalgam expands just enough to make sure that a properly inserted filling will remain firmly in contact with the tooth.

No theory yet advanced gives a satisfactory reason for the existence of these dimensional changes, which I call *reaction expansions* to differentiate them from *thermal expansions*. The prevailing belief is that silver causes expansion and tin contraction. Adjusting the composition of a dental alloy so that its amalgam will show a desirable reaction expansion is, therefore, regarded as "balancing" the opposing tendencies of the component metals.

A study of the modifications produced by systematically varying the conditions that affect reaction expansion has finally led me to formulate a simple theory that seems consistent with all facts at present known. I shall not enter into a consideration of this theory here, but shall merely present some of the experimental evidence upon which it is based.

Black had observed that some amalgams contracted a little before they expanded.[2] In a paper before the American Institute of Mining Engineers[3] I pointed out that the typical reaction expansion of a dental amalgam is characterized by four consecutive stages: (1) rapid contraction to a minimum; (2) somewhat slower expansion to a maximum; (3) considerably slower contraction to a second minimum; (4) very much slower expansion to a second maximum. One or more of these stages can be masked by suitable mechanical treatment of the amalgam.

The gradual changes in shape that the reaction expansion curve can be made to undergo by systematic variation of influencing conditions are particularly well shown by a series of forty-two curves obtained during an investigation of effects produced by varying both the size of particle in which a dental alloy is cut and the pressure under which its amalgam is molded into a test specimen. For this investigation a large quantity of alloy fillings from the same melt was sorted by standard sieves into five samples. The particles of the first sample passed a sieve with 100 meshes and were retained by one with 115 meshes to the inch. The particles of the fifth sample passed a 200-mesh sieve. Unsorted alloy, comprising a mixture of all sizes passing 100 meshes, furnished a sixth sample.

The reaction expansion at 37.5° C.

[1]Abstract from a paper presented at the Washington meeting of the American Physical Society, April 22, 1921; reprinted from the *Physical Review*, XVIII (1921), 108-13.

[2]G. V. Black, "The Physical Properties of the Silver-Tin Amalgams," *Dental Cosmos*, XXXVIII (1896), 982.

[3]A. W. Gray, "Metallographic Phenomena Observed in Amalgams," *Amer. Inst. Min. and Met. Eng. Trans.* LX (1919), 684, 693; *Jour. Nat. Dental Assoc.* VI (1919), 913, 918.

was determined for seven specimens from each of the six samples of alloy. The packing pressures under which amalgam from each sample was molded were increased in geometric progression from 25 to 1,600 kg. per cir. cm. In order to obtain the required plasticity a greater mercury-alloy ratio was used with the finer samples than with the coarser ones, but otherwise packing pressure and size of alloy particles were the only factors that were varied.

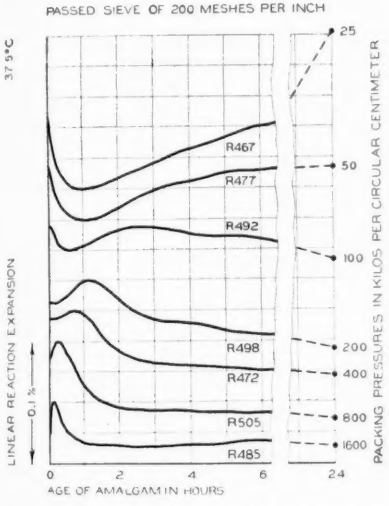


Chart 1.—Influence of packing pressure on the reaction expansion of a dental amalgam made from an alloy containing silver, tin, copper, and zinc. Approximately 69 per cent silver.

Chart 1 shows how variations in packing pressure affect the reaction expansion of amalgam from the sample of alloy that passed a 200-mesh sieve. The distance from one horizontal line to the next represents a change of 2.5 microns (1/10,000 inch) in the diameter of a freely expanding amalgam cylinder one centimeter in diameter, *i.e.*, a linear expansion of 0.025 per cent. Since an observation was taken every minute during the first seven hours after a cylinder was molded, the plotted points merge into a continuous line for each specimen. The change in twenty-four hours is indicated by a single dot at the right of the chart. Subsequent changes have been followed for several months and are still under observation.

The chart shows that each increase in packing pressure is accompained by an increase in the rate of reaction (solution of the alloy in the mecury followed by crystallization of the amalgam), each prominent feature of the expansion making its appearance earlier than in the preceding curve. The influence of pressure change is very much greater at the lower pressures. For example, the amalgam packed under 25 kg. per cir. cm. requires about a month and a half to reach the first maximum. Doubling this pressure results in the maximum being reached during the first twenty-four hours. Another doubling shortens the time to about two and one-half hours. Additional increments of pressure progressively hasten the appearance of this maximum until under 1,600 kg. it is reached in less than ten minutes. At the same time, the increase of pressure progressively obliterates the initial rapid descent preceding the first minimum, and it finally obliterates some of the following rise toward the first maximum. It also hastens the appearance of the second minimum, which is reached in about three weeks with 50 kg. and in about three hours with 1,600 kg. With this alloy the rise from the second minimum to the final maximum is negligible, being no more than one micron per centimeter, or 0.01 per cent.

Chart 2 shows how variations in size of alloy particles affect the reaction expansion of amalgams packed under 25 kg. per cir. cm. Six more similar groups of curves have been charted, one for each of the other six pressures represented in Chart 1. The figures to the right of each curve give the number of meshes per inch of the sieve that passed and the sieve that retained the alloy used

for the amalgam represented by the curve. The curve at the top of the chart was obtained from the unsorted dental alloy, that is to say from alloy in which particles of all the various sizes represented by the other curves were mixed in proportions that yielded a commercial product of the highest grade.

The control of the reaction expansion produced by this blending of various sized particles is evident on comparing

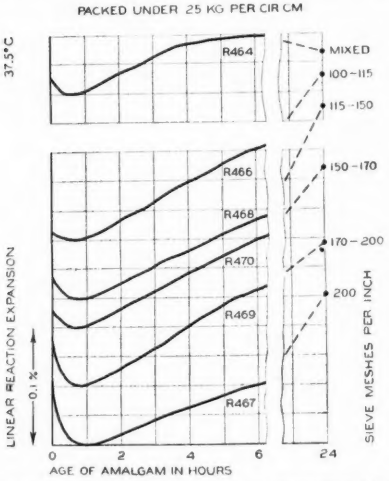


Chart 2.—Influence of size of alloy particles on reaction expansion. Amalgam from alloy of same composition as in Chart 1.

the curve of specimen R464 with the other curves on the same chart, especially when the comparison is extended to include observations made at intervals during a period of several months. For example, specimen R467 expanded 0.18 per cent beyond its first minimum, or 0.11 per cent beyond its diameter when observations began a few minutes after molding, before it attained its first maximum a month and a half later. The other amalgams from the sorted particles of alloy behaved very much like this, altho gradual changes in the expansion curve are noticeable as the alloy becomes progressively coarser.

In contrast with the specimens from sorted particles, R464 attains its first maximum in a few hours, with an expansion of less than 0.05 per cent beyond its first minimum, or about 0.03 per cent beyond its initial diameter. Contraction of about 0.02 per cent to the second minimum, and final expansion too small for reliable measurement, leave the amalgam about 0.02 per cent larger than when first measured. The same amalgam when packed under 50 kg. gives an expansion curve that is practically the same in all respects as the curve of R464.

The limitation of dimensional changes exhibited by the curve of R464 is not an accident of experimental procedure. It is a direct consequence of blending alloy particles that differ in size; this is shown by many almost identical curves obtained during routine tests of different lots of similarly made alloy.

The charts not reproduced in this paper show that, as the packing pressure is increased, the effect of variation in size of alloy particles becomes progressively less.

The contraction found when amalgam from a properly adjusted dental alloy is packed under a very high pressure does not in any way prevent the making of a tight tooth filling, because packing hard enough to cause contraction in such an amalgam will stretch the resilient dentin more than enough to make it follow the slight shrinkage of the filling. In fact, moderate contraction after very tight packing is an advantage, in that it relieves to some extent the straining of the tooth. The tighter the packing, the better the filling, because heavy packing pressure not only adds to the strength of the amalgam, but also shortens considerably the time required for it to complete all its dimensional changes and become stable. Moreover, it secures much better adaptation of the filling to the cavity walls and, consequently, reduces liability to leakage.

The packing pressures used in this in-

vestigation extend from well within the dental range to considerably beyond it. The mean effective packing pressures employed by different individuals, in condensing amalgam fillings with dental instruments, vary widely. I found the average for four individuals to be 68 kg. per cir. cm. The average deviation from this was 64 per cent; the difference between the highest (234 kg.) and the lowest (17 kg.) was 321 per cent.[4] Such deviations taken in conjunction with the pressure effects shown in Chart 1 indicate that, regardless of the accuracy of the particular device employed for measuring the dimensional changes, too much reliance must not be placed on comparisons of dental alloys that are based on expansion tests of amalgams packed by hand pressure or by mallet blows.

Control of tempertaure is also important. Since the linear thermal expansivity of a dental amalgam is about 0.000025 per degree centigrade, a temperature variation of one degree will change the length of a one-centimeter specimen 0.25 micron. Results obtained at uncontrolled room temperatures with an interferometer sensitive to 0.005 micron are, therefore, not nearly so reliable as results obtained with a less but sufficiently sensitive instrument and accurate control of temperature. The dilatometer used for obtaining the curves of Charts 1 and 2 is accurate to 0.05 micron; the temperature of the specimen during measurements seldom varies 0.01° from 37.5° C., or whatever other temperature is selected for the measurements.

The reaction expansions of over five hundred amalgam specimens have been measured under accurately controlled conditions that have been systematically varied. Some specimens have been observed at regular intervals for about two years. In every case the expansion curve was found to conform to the behavior outlined above. Many examples were obtained of all four stages showing in the same curve.

From among the many interesting cases that might be cited as examples, only two will now be mentioned to illustrate long continued dimensional changes of considerable magnitude. Both specimens were prepared from commercial dental alloys by amalgamating according to the directions furnished by the manufacturers and packing under 50 kg. per cir. cm. One specimen, made from a coarse-grained non-zinc alloy, took more than a year to reach its first maximum. During this period it expanded as much as 0.48 per cent. The other, from an alloy containing zinc, reached its first minimum in half an hour, after contracting about 0.04 per cent. It then expanded 0.01 per cent to its first maximum, which was reached within three hours after molding. The second minimum was reached in about a day, after a contraction of 0.02 per cent below the first minimum, or 0.06 per cent below the diameter when observations began. After this, the amalgam steadily expanded toward its second maximum, which was not reached in eight months, when observations had to be discontinued because the cylinder had grown so large that readjustment of the dilatometer would have been necessary for further measurement. The diameter of the specimen had increased 1.28 per cent and was still expanding. This abnormal expansion is not attributable to the zinc contained in the alloy.

The phenomena described in this paper are just what ought to be expected from a consideration of conditions that influence diffusion, solution, and crystallization. Accurate measurements of the dimensional changes that I have termed *reaction expansions* ought to throw light on other problems of metallography and physical chemistry.

[4]See reply to discussion of my paper entitled "Transition Phenomena in Amalgams," presented at the Columbus meeting of the American Institute of Mining and Metallurgical Engineers, October, 1920 and reprinted in *Jour. Nat. Dental Assoc.*, VIII (1921), 491.

THE ACTION OF MEDICAMENTS UPON THE SUPPORTING TISSUES OF THE TEETH OF DOGS[1]

By GUTHRIE McCONNELL, M.D., LINWOOD G. GRACE, D.D.S., and ALPHONSE LANG, B.B.

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

IN THE experiments undertaken by us, we attempted to determine, as far as possible, the effects that different medicaments would have upon the supporting structures of the teeth. There has been much discussion as to what those effects would be, but apparently very little work had been done with that idea in view. Our plan was to take the living animal, apply the medicament to different teeth at different periods, then kill the animal and examine the teeth and adjacent tissues. By so doing we hoped to draw conclusions as to the effect of the various drugs used.

There are, however, certain conditions existing that make it somewhat difficult to compare our results with those occurring in the tissues of the human being. These must be taken into consideration when the results are reviewed. In the first place, the teeth operated upon were normal, there was no decay or destruction, consequently the surrounding structures were in a normal condition. The density of the dog's tooth and of the adjacent bone is much greater than that of the human being. This became very evident in the decalcifying and cutting of the tissues. A third and very important factor is the peculiarity of the arrangement of the terminal root canals. Instead of one or two fairly large canals as in the human tooth, the number of terminal canals in a dog's tooth may be anywhere from twenty to fifty. They are extremely fine and branch off at all angles. There is not the same opportunity in them for the escape of medicaments into the surrounding tissues.

For the purpose of control, several jaws of normal, untreated dogs were X-rayed and sections of teeth made and examined under the microscope. They showed a very thick and dense peridental membrane and a pulp that was conspicuous in its extremely rich blood supply. The layer of odontoblasts was very marked in all instances. No abnormalities were seen in any of the non-operated animals.

The methods of operation employed were as follows. This work was done by L. G. Grace.

In order to facilitate handling and anesthetizing the dogs, morphine in various amounts was injected subcutaneously thirty minutes before operating. One-half up to one and one-half grains was tried. It was found that best results were obtained by giving one and one-half grains in about forty-five minims of water. Ether was used in all cases for the anesthetic.

After the dog was under the influence of the anesthetic the mouth was propped open and the mouth and throat packed

[1]From The Research Institute of the National Dental Association.

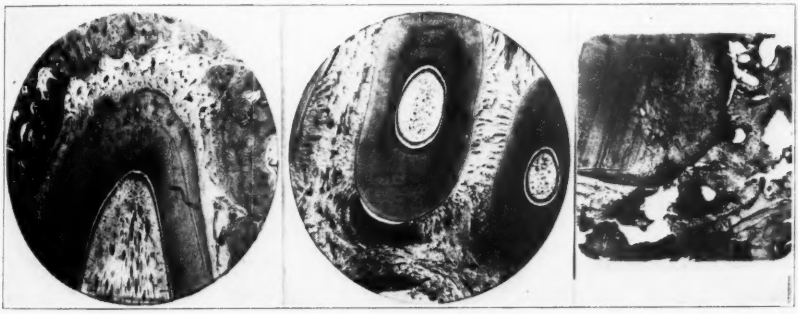
with gauze. Anesthesia was continued thru the nose.

The operation was carried out under aseptic conditions. The tooth to be operated upon was cleansed by wiping first with 95 per cent' alcohol, then with tincture of iodin, followed by again wiping with 95 per cent alcohol. With a sterile fissure bur in the dental engine about two-thirds of the crown was cut off. A large round bur was then used to enter and enlarge the pulp chamber and to gain access to the canals. The canals were first entered with a sterile barbed broach and as much of the pulp tissue as possible removed in this way. The canals in a dog's tooth are usually large and in the molars and premolars, straight. The cuspid root is curved distally and is quite long. Difficulty was often encountered in thoroly cleansing this canal. Gates Glidden drills and Kerr reamers, both hand and engine, were used following the barbed broach. Every care was used to prevent any of the instruments from passing beyond the apex. It was our object to remove all of the pulp tissue but not to mechanically injure in any way the supporting structure. As the large cuspid tooth does not have a single foramen at the apex but may have as many as thirty small ones it will be seen that this was not an easy task. Indeed in operating on this tooth it is doubtful if we ever succeeded in entirely removing all of the pulp tissue.

There was usually considerable bleeding following the removal of the pulp. Sterile paper absorbent points were used to take up the blood. A styptic was never used to check the bleeding as there might have been a question as to the final results. It was desired that not more than one drug be used in any one tooth.

Four different treatments were used. These were formaldehyde in 4 per cent solution and 1 per cent solution, chloramine-T in the form of a paste and the silver reduction or Howe's method.

The treatment with formaldehyde was made by first drying out the tooth with sterile absorbent points and then placing in the canal an absorbent point which had been soaked in the formaldehyde solution. The excess of the medicament was taken up with pellets of



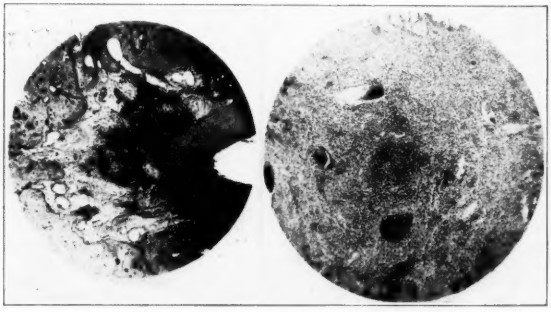
1 2 3

Figs. 1, 2, 3.—Fig. 1, molar, normal. Low power showing multiple foramina and normal relation of tooth with surrounding structures. Fig. 2, dog No. 2, molar. Low power showing normal pulp, dentin and peridental membrane, also some squamous epithelium. Fig. 3, dog No. 2, canine. Tooth with 10 per cent formalin sealed in. Very low power showing cyst at opening of canal, cellular infiltration and absorption of alveolar bone.

sterile absorbent cotton and the tooth sealed with an oxy-phosphate cement filling. In using the chloramine-T (paratoluene - sodium - sulpho-chloramide, J. F. Hartz Co.) a creamy paste was made with the medicament and sterile distilled water. This was pumped into the canal, working it well up to the apex. A cement filling was then inserted.

In treating the tooth according to the silver reduction or Howe's method the tooth was first dried out and then solution A, made up according to directions given by Dr. Howe[2], introduced with a glass dropper. This was worked well up in the canal with a sterile broach and then a drop of solution B (10 per cent formaldehyde) added. The reaction was allowed to take place, the excess of the drugs taken up with pellets of sterile absorbent cotton and the treatment repeated until, as far as could be determined, the dentin had been stained quite black. A drop of solution A was finally introduced to neutralize any excess formaldehyde that might still be present. The tooth was then dried with sterile absorbent points and pellets of cotton, a dry sterile absorbent point placed in the canal and the tooth sealed with a cement filling.

Dog No. 1.—The medicament used upon the first dog was 10 per cent formalin, three teeth being used. Reference to Table I will show which teeth were operated upon, the date of operation, and the number of days which elapsed between the operation and the date upon which the dog was killed. The X-ray plate showed an apparent loss of density in the neighborhood of the apices of the cuspids.



4 5

Figs. 4 and 5.—Fig. 4, dog No. 4, molar. Ten per cent formalin sealed in tooth. Low power showing proliferation of connective tissue infiltration by plasma cells and well-marked absorption of alveolar bone. Fig. 5, dog No. 5, lower left cuspid. Low power, showing early granuloma with plasma cell infiltration.

Microscopic examination showed similar changes occurring about the apices of the two cuspids. Very many plasma cells are present in the peridental membrane, particularly about the apex, but present to some degree up to the level of the highest of the multiple foramen, of which there were many. In the peridental membrane at the apex there were found several small empty spaces surrounded by very dense plasma cell infiltration. The impression given was that of broken down tissue. Comparing this section with that of the

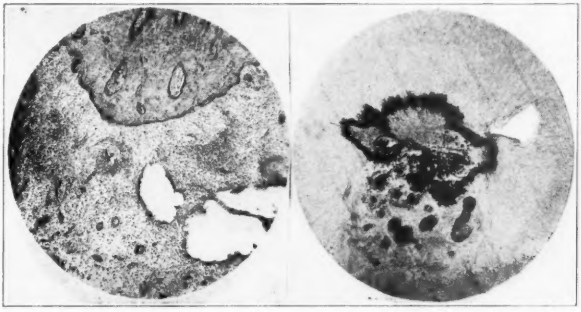
[2]*Dental Cosmos,* Vol. LIX, September, 1917.

normal control it seemed as if there had been some absorption of the bony trabeculae adjacent to the apex. The neighboring blood vessels were quite engorged, and many red blood cells were lying free in the tissue. No polymorphonuclear leucocytes were found.

The premolar did not show any changes but it had been exposed to the formalin for only six days as compared with the four and ten weeks of the two other teeth.

Dog No. 2.—The lower right cuspid was treated with 10 per cent formalin. Twenty-one days later the dog died; the jaw was then removed and the specimen examined. The X-ray film was negative. Microscopic examination shows a very intense infiltration of the peridental membrane by plasma cells, occurring in large masses. One section is particularly interesting as it shows an unusually large canal extending to the surface of the tooth, at the outlet of which there is a small, but well-defined, empty space giving the appearance of beginning cyst formation. The walls consist of closely packed plasma cells enclosed within fine fibrils of connective tissue. Another section shows a larger empty area of similar character some distance from the tooth and close to the alveolar bone. The blood vessels were somewhat engorged. No polymorphonuclear leucocytes were found. An untreated premolar from the same dog showed no abnormal conditions.

Dog No. 3.—In this experiment the right cuspid was treated with 10 per cent formalin. The pulp was removed from the left cuspid and a sterile absorbent point sealed in, but no medicament was used. Eighty-seven days after the treatment with formalin and thirty-one days after the operation on the left cuspid, the dog was killed. X-ray films were negative. Microscopic examination of the right cuspid showed a great infiltration by plasma cells of the apical portion of the peridental membrane. In this area there was a very evident proliferation of capillary blood vessels, all of which were much congested. No polymorphonuclear leucocytes were found. The histological picture was that of a dental granuloma. There also was distinct hypercementosis with absorption. The left cuspid, which was untreated, at the end of thirty-one days showed a slight plasma cell infil-

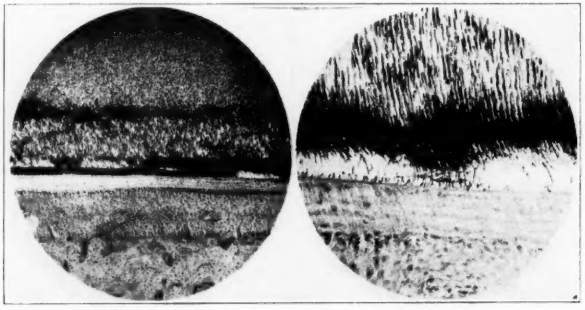


6 7

Figs. 6 and 7.—Fig. 6, dog No. 6, lower right molar. Low power, showing an infection on the tip of the root and multiple foramina. Fig. 7, dog No. 6, lower left molar, cross-section. Low power, showing penetration of silver nitrate in the tubules of the root canal.

tration with numerous capillaries considerably congested. The condition resembled that found in the tissues adjacent to the right cuspid, but very much less marked.

Dog No. 4.—Both the right premolar and the right cuspid were treated with 10 per cent formalin and the dog killed thirty-nine days later. The X-ray films showed a large and very well-defined area of decreased density close to the apex of the cuspid and a smaller, but also well-defined area at the apex of the anterior root of the premolar. Microscopic examination of the tissues supporting the premolar shows a very intense plasma cell infiltration of the peridental membrane, accompanied by the formation of many new capillaries. Some red blood cells are found lying free within the tissues. There also has been an increase in the amount of connective tissue, particularly at the apex. There seems also to have been some absorption of the alveolar bone in this region. No polymorphonuclear leucocytes were found. The tissues surrounding the cuspid proved particularly interesting. At the time of the treatment nothing abnormal was noticed in the tissues. When, however, the jaw was removed, a sinus apparently connecting the apical tissues and the external surface was found. The microscopic examination of this specimen showed a tremendous infiltration, not only of plasma cells, but of polymorphonuclear leucocytes as well. Around the apex the identity of the peridental membrane was lost, much of the adjacent alveolar bone of the jaw was absent and the medullary spaces filled with granulation tissue. Thruout this infiltrated area were great numbers of large ameba, many of which contained red blood cells. Altho a positive statement cannot be made yet it seems that the destruction of the tissues with the formation of the sinus might be due to the effects of the medicament.



8 9

Figs. 8 and 9.—Dog No. 6, lower left molar, longitudinal section. Fig. 8, low power, Fig. 9, high power, showing the penetration of silver nitrate up to the cementum but not entering it.

Dog No. 5.—Left cuspid and left premolar treated with 4 per cent formalin twenty-four days before the dog was killed. Right cuspid was filled with a paste of chloramine-T one week before death. X-ray films show nothing positive. Microscopic examination of the left cuspid showed little change in the peridental membrane close to its attachment to the tooth. A little distance away from such attachment there

was a slight infiltration by plasma cells, with a few small areas in which these cells were abundant. No polymorphonuclear leucocytes were found. The left premolar tissues showed practically nothing abnormal. Apparently there had been no reaction. The right cuspid tissues also showed no changes, the chloramine-T apparently causing no disturbance.

Dog No. 6.—In this experiment the left cuspid and the left premolar were treated with silver nitrate and formalin according to Howe's method. The right premolar was treated with 4 per cent formalin. The dog was killed fourteen days after the above mentioned treatments. The X-ray films showed nothing other than an increased density of the two teeth treated with silver nitrate. Microscopic examination of the left cuspid did not show the slightest change in the peridental membrane or in any of the other supporting tissues. There was no sign of silver precipitation external to the tooth. The section of the tooth showed a very well defined zone of silver precipitation which had not extended more than half the thickness of the dentin. A cross-section of the left premolar showed similar conditions with the exception that the silver had penetrated to the inner layer of the cementum with occasional extensions into it. In some of the minute dental canals there had been a precipitation of silver, yet in others there was no indication of the silver having penetrated. The microscopic examination of the lower right premolar, treated with 4 per cent formalin, showed the peridental membrane at the apex with a diffuse but very well marked infiltration by plasma cells. Some of these cells were

TABLE I

Tooth	Treatment	Date	Date Dog Killed	No. of Days Tooth Under Treatment
Dog No. 1 L. cuspid	10 per cent formalin sealed in canal	12-12-19	2-19-20	69
R. cuspid	Same	1-22-20		28
R. premolar	Same	2-13-20		6
Dog No. 2 R. cuspid	Same	12-13-19	1- 4-20	21 (dog died)
Dog No. 3 R. cuspid	Same	1-23-20	4-19-20	87
L. cuspid	Sterile absorbent point. No medicament used	3-19-20		31
Dog No. 4 R. cuspid	10 per cent formalin sealed in canal	2- 9-20	3-19-20	39
R. premolar	Same	2- 9-20		39
Dog No. 5 L. cuspid	4 per cent formalin sealed in canal	4-12-20	5- 6-20	24
L. premolar	Same	4-12-20		24
R. cuspid	Chloramine-T	4 29-20		7
Dog No. 6 L. cuspid	Howe's method. Sterile Absorbent sealed in canal	4-27-20	5-11-20	14
L. premolar	Same	4-27-20		14
R. premolar	4 per cent formalin sealed in canal	4-27-20		14

found in the neighboring narrow spaces. In a few small areas the cells occurred in closely packed masses. There were numerous small, congested capillaries in apical region. No polymorphonuclear leucocytes were found. There evidently was a comparatively slight but distinct reaction.

Altho the experiments reported are not sufficient to prove the case completely, yet with certainty they indicate that formalin in a solution of 10 per cent has a destructive effect upon the supporting tissues of the teeth when sealed within the tooth. The greater the time allowed for action, the greater is the effect upon the tissues. Those teeth examined within one or two weeks after the treatment showed very little change in the supporting structures. Those in which the time elapsing was greater showed more marked changes.

The conclusion would seem warranted that the sealing of formalin solutions of 10 per cent or greater within the pulp cavity will cause serious disturbances of the tissues.

As far as the silver nitrate method is concerned, no conclusions can be drawn, but the statement can be made that in two instances the silver had not escaped from the tooth nor was there any reaction in the surrounding structures.

It had been hoped that a much larger series of experiments would have been reported, but it was difficult to obtain the necessary animals.

Discussion

C. E. Woodbury, Council Bluffs, Iowa: I did not understand the conclusion that was arrived at in regard to the use of the chloramine-T.

Dr. Grace: We did not arrive at any definite conclusions in this work, simply because we did not carry our studies thru enough cases. We can only tell what happened in the experiments as we performed them and you must make your own conclusions. The chloramine-T was used according to the method suggested by Carrel-Dakin. The tablets are made up in the form of a paste with sterile distilled water. The paste was pumped up into the canal and as far as we could determine there was no reaction in the supporting structure of any kind.

L. J. Walker, Clarksburg, West Virginia: Were any series of experiments made without the use of any medicaments?

Dr. Grace: We made just one in which the pulp was removed and the sterile absorbent point sealed in the canal after the blood had stopped, and there was some evidence of reaction to the supporting structure. Whether that was due to a mechanical injury or whether technic was faulty, I cannot say.

Arthur H. Merritt, New York City: I observe that in your use of formalin you carried it as far as you could toward the apex of the tooth. I would not regard that as good in general dental practice. In that way you are carrying your solution very close to the apex inevitably, with a greater chance of injury to the surrounding tissues in the region of the apices.

Dr. Grace: The sterile point was soaked in the medicament and as much as possible allowed to drain off, so that we did not have a great lot of excess; I mean the canal was not flooded with the solution. Just what the point would absorb was placed in the canal. Of course that point was placed as near the apex as possible. We never succeeded in placing them beyond, because in the structure of the dog's tooth there are numerous foramina, which are very small, and you would have to actually drill thru before you could penetrate the surrounding tissue.

Dr. Merritt: There is another thing in which it would hardly seem comparable, and that is the fact that it was left in there for a very considerable period of time. Some of them were left several weeks.

Dr. Grace: We left some of them in as much as six weeks. We wanted to note what the ultimate reaction would be.

Herman Gruer, New York City: If you left it in for a few days and then took the medicament out wouldn't you want to see the further effect without the medicament in—see whether the tissues would come back to their normal state or whether they would continue to degenerate?

Dr. Grace: That is another phase to which this experiment might be carried, and it is merely an indication of what might be done in a study of what effects medicating a tooth has upon the supporting structure. You could carry the experiment along in such a way as to duplicate or to simulate every condition that you would meet in the mouth. I do not

say duplicate, because you cannot duplicate conditions in an animal's mouth that you find represented in a human mouth, but you might carry these experiments along to approximate every condition which you meet in practice.

E. E. Haverstick, St. Louis: Had any of these root canals been filled?

Dr. Grace: We did not carry the experiment thru to filling the canals. The dog was killed before the medicament was removed from the canal and the sections of the jaw made with the filling, and so forth, right in place. We did not open the canals at all after once sealing the medicament in the tooth. The dog was then carried along under observation and any tendency toward swelling noticed. We do not note any external reaction except the ones which I have mentioned in which we found a fistula established on the alveolars, and at the end of the time we killed the dog and his jaw was removed and histological sections were made.

Dr. Haverstick: It does not seem to me that after forty-eight hours these medicines should remain in the tooth. That is, it does not seem to me that we would permit them to remain in the tooth longer than that in the human mouth.

Dr. Grace: It very often has been the practice, tho, to renew it. You do not allow that dressing to remain, but you remove it and place a second batch in so that the patient would get a second dose, and the strength that had been dissipated from the first dressing would be renewed by the second dressing.

Dr. Price: Did you make observations as to the difference when the medicament was placed in a tooth that had been pulpless for some time and a tooth where the pulp had been immediately removed?

Dr. Grace: We did not place the medicament in any pulpless teeth. We placed the medicament in teeth after the pulp had been removed. The entire operation was done at one time. The dog was anesthetized and we removed the pulp and allowed time for coagulation to take place at the apex due to the mechanical tearing out of that pulp and the bleeding that resulted. As soon as the bleeding had stopped we placed the medicament in the tooth and sealed it up. Nothing more was done with that tooth at all until the dog was killed and the section made.

Dr. Price: Dr. McConnell, the pathologist who worked with Dr. Grace in this work, when asked whether or not he would have formalin placed in a tooth of his and under what conditions he would have it done, replied: "Not under any conditions." It is a matter of considerable significance that a pathologist with years of experience, recognizes structural changes and their seriousness in relation to the future health of that tissue—I say his judgment is of very great importance to us, and his reaction to this whole experiment was that formalin is a very dangerous drug to put in the teeth even under exacting conditions.

Dr. Grace: You will notice that the formalin that we used was a 10 per cent solution of formalin, which means only 4 per cent of available formaldehyde. In the formalin preparations that are usually used you have equal parts of formalin with something else, and in such a medicament you will have from 16 to 20 per cent of available formaldehyde. With 4 per cent we were only using one-fifth of the strength that is commonly used in dental practice.

Dr. Merritt: May I ask that if this pathologist who made this observation had any suggestions to make as to what could be safely and effectively used in pulpless teeth?

Dr. Grace: The chloramine preparations which we used here showed no reaction at all in the supporting structures. Paratoluene-sodium-sulphochloramide is the technical name for it. It is put up under various trade names, such as nuklorere, chloranzene, chloramine-T, etc., and they are all apparently the same thing; practically every drug house puts up a preparation which is supposed to be this particular form of the Carrel-Dakin compound. It is a water-soluble solution which gives up chlorine in its nascent state and depends for its efficiency as a sterilizing agent on the nascent chlorine which is liberated. We found that this was an efficient germicide under certain conditions, and we therefore used this in the form of paste. We took these tablets and mixed them with sterile distilled water into a creamy paste, and this was worked well into the canal. The idea was that by working them into a paste we would obtain the maximum action of this drug over the longest possible time. If you were to use a solution on paper or a cotton point or a cotton dressing, that chlorine would be dissipated and you would not have so much chlorine taken up in the solution.

Harold De Witt Cross, Boston, Massachusetts: The silver reduction method showed no reaction, did it?

Dr. Grace: As far as we could determine there was no reaction in the supporting structure.

Dr. Merritt: How long is the chlorine effective and have any experiments been made

to test its effectiveness in pulpless teeth that have become gangrenous—septic?

Dr. Grace: Just as long as nascent chlorine will be given off from this point, so long will it be effective.

Dr. Gruer: In these experiments the formalin which is generally regarded as harmful was used upon animal tissue. I do not think in any general practice formalin would be used to sterilize a canal which was opened under general antiseptic conditions, which is generally regarded as harmful. In that case no medicament is used, but in a pulpless tooth that has become infected, there would be a question as to whether formalin shall be used to get as strong a medicament as possible, or whether it would not be too harmful to use. Of course these experiments showed an effect upon normal tissue by such a strong drug, but the question is whether the mild medicament which might be used in such cases, such as the essential oil, or I might say peroxide of hydrogen, would show an effect upon a newly opened pulp, and also what further effect there would be upon the tissues in a gangrenous or a granulomatous process— what effect then would be given by the formalin; whether it would tend to dissipate the granuloma or whether it would increase the area of the granuloma?

Dr. Grace: You cannot take a human jaw and section it. It is difficult to get postmortem cases for that work, nor can you treat them just when the patients are going to die. You must work with animals and you must work under laboratory conditions, so due allowance must be made for that fact when you carry these conclusions into general practice. As regards the milder antiseptics, we were testing the antiseptics that had proved to be efficient germicides.

In closing let me emphasize once more that we are not trying to tell you that these results are absolutely conclusive; it is a step in a direction which we feel is important. Everyone should know before he puts any drug in the mouth what effect it will have on normal structure; and it was with a view of throwing light on this particular subject that these experiments were undertaken. There have not been enough of them taken. They should not simply be carried into six dogs with four teeth in each dog, as we have done, but into hundreds of dogs, maybe thousands of dogs; and then if you get the summary of the entire results you will be able to draw some definite conclusions, always allowing for the fact that in a dog's mouth you cannot absolutely have the same conditions that you would have in a human mouth.

PENNSYLVANIA'S METHOD OF SOLVING THE PROBLEM OF TOOTH DECAY AMONG SCHOOL CHILDREN

By C. J. HOLLISTER, D.D.S., Harrisburg, Pennsylvania

(Read before the Chicago Dental Society, January 19-21, 1922)

EVER since medical inspection of school children became an integral part of our public school system, attention has been focused on the teeth. This has been but natural, since irrespective of the location of a school or social status of the pupil, no physical defect occurs with such frequency as dental caries. Effort to correct this condition has resulted in the establishment of dental clinics in large numbers thruout the United States.

Many of these clinics have been in operation for ten years or more; therefore ample time has elapsed in which to judge their effectiveness. Those in a position to know assert that while dental clinics have been of great service, they are entirely inadequate for the work at hand. Their function has been to repair the damage incident to dental caries, and not to prevent its development. In communities where the dental clinic is operating, the call for service is so great, that the clinic is able to give little more than emergency relief of pain. For instance, a boy with an aching six-year molar can obtain immediate relief service, but his schoolmate with teeth just beginning to decay, but giving no trouble cannot get service until his teeth have decayed almost, if not entirely, beyond repair. Therefore the authorities, realizing that the dental problem among school children primarily requires preventive measures, have developed campaigns based on the simple principles of dental prophylaxis. Perhaps the best example of such a dental campaign is to be found in Bridgeport, Connecticut, where under the able direction of A. C. Fones a prophylactic dental service was installed about six years ago. The success attending this piece of work has long since taken it out of the class of experiments, and it now stands as a splendid demonstration of the practicability of dental prophylaxis.

The method our Department of Health is pursuing is based on the plan of Dr. Fones with modifications. The personnel of the Dental Division of the State Department of Health of Pennsylvania is as follows: a chief, an assistant, who is a dentist, two dental hygienists, and a chauffeur. The equipment used includes a completely equipped, specially built dental office, mounted on a truck chassis, in which the dentist operates. The dental hygienist's equipment consists of two folding or two portable dental chairs (army type), sterilizer, medicaments and hand instruments; no engines are used by the dental hygienists. The method of operation is as follows: First, a formal request is sent to the local school board for permission to demonstrate the feasibility, practicability, and great need for dental hygiene to their school children, without expense to them. When a school board has granted permission, forms are then forwarded to the local superintend-

ent with the request that he select one or two fourth-grade rooms in which to conduct this demonstration, and that by the use of these forms he obtain the written consent of the parent or guardian of each child.

Upon the arrival of the demonstrative dental clinic, space is selected in the school building for the placing of the portable outfit of the dental hygienist. This is sometimes in a principal's office, vacant room, medical examination room, cloak room, the end of a hall, stair landing or even in the basement; in fact, wherever there is good light. Usually the setting up of the equipment takes about one-half hour. Then the children, two at a time, are brought to the dental hygienists to have their teeth cleaned. This occupies from twenty to thirty-five minutes for each child, and during this time, the dental hygienist talks to the child individually, telling him or her how, why and when he should use a toothbrush. During the period that the clinic operates in a schoolroom, the dental hygienist frequently goes to the classroom, giving talks on hygiene, both dental and general, and training the children in toothbrush drills. It is really wonderful, how the children respond to this work.

The object of our division in making visits to different communities thruout the state is not to care for a large number of children, but rather to show how all children can be given prophylactic treatment and education efficiently and economically.

During the demonstration period in a town, which usually occupies two weeks, arrangements are made for the dentist in charge to give talks before Rotary, Kiwanis, Lions, Civic and women's clubs, and similar organizations. Thru these organizations, an earnest effort is made to interest not only school authorities but all other leaders of the community, for such an innovation could scarcely be incorporated into the school system without popular support. The local dentists are given prior notice of our intended visit, either thru local societies or individually. At the present time, the state finances only the demonstration, and we attempt to interest local authorities, sufficiently so that they will with local funds permanently establish this service for their children.

The results coming from our efforts have been very gratifying, in that approximately fifteen communities have taken up, in a permanent form, some kind of dental service for their school children, and all of the communities visited are seriously considering the problem. We feel very much encouraged to learn that we will finally attain our desire and slogan: "Clean mouths for all Pennsylvania's school children."

"A clean tooth never decays." Some authorities disagree on this statement, and I will not offer argument on the subject, except to mention the results of Dr. Fones' work in Bridgeport, where in six years dental caries in school children were reduced 50 per cent by prophylaxis and education. We can but agree that diet, prenatal and after birth, is a great factor in susceptibility to caries, and where that has been faulty we say "all the more is thoro prophylaxis essential."

Duty of dentist to the public: Ethics is the professional application of the golden rule. If we have something that is good for the public to know, should we not on that basis give it to them? In other words, we should impress the words "importance of care of the mouth and teeth."

I desire to offer an illustration which I think proves without qualification that our activity should receive the undivided and enthusiastic co-operation and support of the dental profession, in that it shows a direct benefit professionally and financially to the profession. In starting out the campaign this fall,

one community ignored all communications from my office. It being on my direct line of march I was desirous of opening the fall work there, for I knew from experience that should we pass by, later, they would do all in their power to have us return. Two weeks before we started out, I called up the local superintendent of schools to ask what action had been taken on my request. He replied that it had been pigeon-holed. In a very half-hearted way we were asked to come. We went, and three weeks after we arrived they had a dental hygienist at work in their schools, funds for her salary, equipment and maintenance being provided by subscriptions from the Rotary and Civic clubs, Chamber of Commerce, and the local dentists. In less than a month after dental hygiene became a part of their school system the dentists formed a small local society, primarily to aid the dental hygienist program, but they immediately framed a minimum scale of prices, standard office hours with a half holiday, and no Sunday work. They also engaged a prominent dentist to give a clinic before them.

The financial benefits received are almost beyond belief. This particular town had suffered for a year or more, due to industrial depression of its main industry, which had been shut down for that period. When I first talked dental hygiene for the betterment of the condition of children, one of the leading members of the community said to me: "With business as it is in our town, it is going to be a problem, not of making conditions better for the children, but rather a problem of putting bread into their mouths to keep them alive." Having been in this town for two weeks or more I was able to reply in the following way: "In spite of the business depression that has affected your community, I have noticed that the candy stores, soda fountains, and moving-picture houses have been doing a splendid business, which is proof to me that if the public is really desirous of obtaining something it will find a way and we are here to make them want better health for their children." On a return visit to that community, a few weeks ago, I met with the local dental society, and everyone of them reported that they were very busy on pay patients, a large percentage of whom were school children. This condition prevails there, when thru our state at the present time the average dentist is not as busy as he could be.

In preparation for this meeting, I wrote to all of the communities where the dental hygienist is permanently at work, and with your permission I shall read a few extracts from replies received. From the superintendent of schools of West Chester, Pennsylvania: "Miss Lincoln has been at work for about six weeks, and has made herself a part of the school system of West Chester. She is an earnest, hard working, conscientious girl. I believe she is going to make for dental hygiene a place in our school system. I am greatly pleased with the reaction of the children and the attitude of the parents." From the superintendent of the schools of Johnstown, Pennsylvania: "Personally, I believe that the work is progressing successfully and that it is winning interest in the community. The hygienist averages about six children per day. She turns in weekly reports to me." From the executive secretary of the Bradford County Tuberculosis Association: "The teachers and parents are enthusiastic over this work. We are making fine progress." From the dentist to the school district of the city of Scranton: "The personnel last year was made up of the dentist and two dental hygienists. Last year 7,200 prophylaxis cases were cared for; 5,200 extractions, 350 fillings, and 53 public meetings were held. This year there

are 9,500 children with 3,600 complete to date; 1,800 extractions, 300 fillings, and 20 public meetings. Last year there was so much persuasion; this year the children look for us and present themselves, pointing out the teeth which they wish out. That is a pleasing sign, is it not? A canvass of drug stores shows an increase of toothbrush and tooth paste sales of over 25 per cent. Teachers are now showing great interest in our work. We are seeing a great decline in the number of cavities in mouths where we have cleaned them up. We classify the mouths: clean, fair and foul. Last year, we did not have many in the clean class, but we had our share in the foul class. This year, I am proud to say that we have nearly abandoned the last class. The dentists of the town claim, that if we do nothing else but get the children in a nice frame of mind, we will do a wonderful service. We have very few refusals. The dentists are taking more interest in the work than ever. They see now that we are helping them. We have many favorable comments from all sources about our work."

At the National Meeting in Milwaukee last year, I learned of the work of Jackson, Mississippi,[1] in obtaining correction of dental defects of 100 per cent of 1,674 children. Judging from my experience in the past few years that is "short of miraculous." The details of that plan I know are familiar to you. I carried the idea back to Pennsylvania, and it is now in operation in a number of places very successfully.

I want to present one other phase of dental service. A few days ago, one of our state nurses told me that the medical inspector had just finished examining a rural school just outside of Harrisburg, of eighty children, and that eighty children were in need of immediate dental service. One boy was suffering to such an extent that he needed relief. She had taken this boy to one of the local hospitals, where he was afforded only very temporary relief. There is a school dental dispensary, but that is not available for children outside of that school district; hence there was no way in which to relieve this suffering child. While this is a specific case, the conditions found there are not peculiar to that particular community. It is a condition found all over the country, and this is a problem which I believe should receive the attention of the National Association, and that that body should strive to find a probable solution. This last point is made without any plan to offer. "We are seeking light."

I might say that in our state this condition is becoming so acute that if the profession does not find a solution the state authorities will be compelled to.

[1]Gladys Eyrich, "One Hundred Per Cent Good Mouths—How Obtained in the Public Schools of Jackson, Mississippi," *Jour. Nat. Dental Assoc.*, (January, 1922), 3.

HARELIP AND CLEFT PALATE

By M. N. FEDERSPIEL, B.S., D.D.S., M.D., F.A.C.D., Milwaukee, Wisconsin

(Read before the National Dental Association, Milwaukee, Wisconsin, August 15-19, 1921)

IN THE human mouth at the entrance are two fleshy folds, the lips, covered externally by the skin and internally by the mucous membrane.

In the middle part of the outer surface of the upper lip is a vertical depression, groove-like in appearance, called the philtrum. The inside of the upper and lower lips in the middle line joins the gum tissue of the corresponding jaw by a fold of mucous membrane called the frenum. The covering of the margin of the lips is mucous membrane, which is thicker and drier than that of the oral cavity called the vermilion border which is well defined.

In the middle line of the border of the upper lip and at the lower end of the philtrum is a slight elevation, the labial tubercle. On each side of the labial tubercle the vermilion line points upward, and then gently curves downward to the angle of the mouth. In the lower lip the vermilion border is greater in the middle line from which it curves gently upward to the angle of the mouth.

In a healthy person the vermilion border of the lips are of a bright red color and slightly wrinkled. The thickness varies in individuals. This is also true of the amount of redness exposed.

The formation of the upper lip is brought about by the union of the maxillary globular and fronto-nasal processes in embryo. Should these processes fail to unite the result is a defect called harelip. The nomenclature used in the description of this deformity does not resemble the cleft of the hare's lip, which is located in the medium line bifurcating to each nostril (Fig. 1) but may affect any part of the lip. The cleft in the lip of the human being may exist as a mere notch in the vermilion border (Fig. 2), or it may continue into the floor of the nose (Fig. 3).

Harelip may be divided into (a) single or unilateral harelip (complete or incomplete); (b) double or bilateral harelip (complete, Fig. 3, or incomplete). This classification applies to the usual cases that come to the oral surgeon for correction.

Frequently one finds cases of incomplete harelip where the tissue above the fissure are not of normal thickness. The covering is nothing more than the skin. It is smooth, does not contain hair follicles, nor sweat glands. The color is more red and appears to be somewhat like mucous membrane. It may appear like an old scar (Fig. 5).

In some cases the streak of abnormal skin extends to the floor of the nose, and the nostril is usually wider than the opposite one. These patients when operated on should have all of this abnormal thin covering removed, and cared for like a complete harelip in order to obtain a good result.

The shape of the nose in complete harelip is very characteristic. The nostril is broad and flattened out. The cleft of the lip is more common on the left side than on the right. Rose reports that Muller found 142 left-sided against 62 right-sided clefts. Mason, out of 65 cases, found 54 to be unilateral, and of these 35 left-sided to 19 on the right. Kolliker mentions that 165 unilateral clefts, 113 were on the left side, and 62 on the right. In my own observation of

80 cases I find that 70 per cent had a cleft on the left side.

Double harelip is a condition where the fissure may be complete or incomplete on both sides, or it may be complete on one side and incomplete on the other. When the fissure is complete on each side the nostrils are flattened outward. The vermilion border on each side of the fissure extends into the nostril. The central part of the lip frequently extends forward on account of the protrusion of the os incisivum which it covers (see Fig. 4). When this occurs the alveolar process has a double cleft which unites at about the position of the anterior palatine canal, and then may extend backward as a single cleft of the hard and soft palate (see Fig. 6).

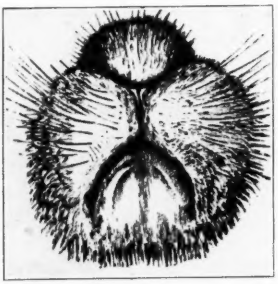


Fig. 1.—A hare's lip. The cleft of the upper lip is in the median line, bifurcating to each nostril.

In a large number of cases where there is a single harelip and a single cleft of the alveolar process the premaxillary bone is turned outward and protrudes, causing the nose to be shifted to one side. In such cases the vomer is usually deflected (Fig. 7).

When To Operate

As a general rule the repair of a harelip should be done just as soon after birth as possible. I usually operate on these cases three to four weeks after birth. While the earlier operation is considered imperative, the surgeon must take into consideration the degree of the deformity, and the amount of vitality of the patient. Frequently patients possess a low vitality due to inherited weakness, or to inability to receive nourishment properly owing to the cleft of the lip and palate. I do not believe that a set of rules can be laid down as to when to operate, as the surgeon must carefully weigh and consider the patient's vitality and resistance to withstand the shock of the operation, or any complication that may arise.

2 3 4

Figs. 2, 3, 4.—Fig. 2, a cleft of the upper lip which is usually described as a notch thru the vermilion border; Fig. 3, a complete harelip extending into the floor of the nose; Fig. 4, a bilateral harelip and alveolar cleft.

TREATMENT: PREOPERATIVE CARE

When a child is born with a harelip the mother should not be allowed to see the infant until the borders of the lip are brought together as close as is possible, and held so by a strip of adhesive tape (Fig. 8). It is well to inform the parents that the deformity can be corrected by an operation, and that results are usually very good. It is of great importance that practitioners who are present at the birth of a child with a harelip should see to it that the holding of the borders of the cleft are held together, or nearly so, with adhesive tape.

The chief reason for this preoperative care is that the pressure brought about by the adhesive tape will greatly assist in molding the lip so that the fissure becomes more narrow. In patients who have a cleft of the lip and alveolar process such treatment often aids in reducing not only the width of the lip cleft, but also narrows the cleft of the alveolar process. I have seen a number of cases where such preoperative care within three weeks caused a wide extensive cleft of the lip and alveolar process to be considerable narrower.

When a child with a harelip cries or laughs the sphincter-like action of the orbicularis oris muscle cannot function-

5 6

Figs. 5 and 6.—Fig. 5 shows a fissure of the upper lip; the covering is nothing more than skin; Fig. 6 is a double alveolar cleft extending backward as a single cleft of the hard and soft palate.

ate normally, so that when contraction occurs each half of the lip pulls away from the center, and therefore exaggerates the deformity. If, however, the

7 8

Figs. 7 and 8.—Fig. 7 is a single cleft of the lip and alveolar process showing the premaxillary bone turned outward and protruding. Fig. 8 shows adhesive tape strapped across the upper lip to hold the borders of the cleft together. This will greatly assist in molding the lip so that the fissure becomes more narrow.

borders of the lip are held together with adhesive tape the edges of the cleft will not be widened nor everted by the child in the act of crying or laughing. The tendency then will, by muscular pull, cause the cleft of the lip and alveolar process to become more narrow during the growth of the child. The narrowing of a cleft during the preoperative care is of great importance to the surgeon in obtaining a better and more cosmetic result.

In cases that have a complete cleft of the lip and alveolar process, and palate, some surgeons recommend the closing of the alveolar cleft first and then at a later time the cleft of the lip, especially so if the Brophy operation is to be performed, as the surgeon has better access to the palate. However, I have abandoned, in most cases, this method for the reason that after the cleft of the lip is closed the sphincter-like action of the orbicularis muscle will usually mold the alveolar cleft so that its borders approximate, and in some cases closure takes place.

In such cases after the cleft of the lip and alveolar process are united I close the palatal cleft several months later. At no time have I found any difficulty in closing the hard and soft palate to arise from a previous operation on the lip.

Anesthesia

In my experience I find that ether is the choice anesthesia for operations on harelip and cleft palate. The Sorenson Ether vapor and Asperating apparatus we find suitable for this purpose. It permits free access to the operating field without interfering with operations of the anesthetists. The ether vapor is pumped into the mouth thru a tube. The nostrils are gently packed with gauze to prevent the blood from running thru the nostril into the pharynx and larynx.

With regard to the position of the patient I prefer the recumbent posture on a table. The anesthetist should stand at the head of the table, the assistant and operator on each side. After the parts to be operated on and the surrounding area have been thoroly cleansed, then bathed with 60 per cent alcohol, the patient is ready for operation.

Operation For Single Harelip

This operation for convenience of description may be divided into four stages: (1) freeing of the lip from its attachment to the maxilla; (2) cutting of the borders of the cleft to obtain symmetry of the nostrils, an invisible scar of the lip, and well-contoured vermilion border; (3) insertion of sutures in the skin and mucous membrane; (4) prevention of lateral tension.

Freeing of the Lip From Its Attachment to the Maxilla

In order to obtain a well-formed lip it is of great importance to thoroly free the lip from its attachment to the maxilla, especially should the ala nasi be dissected freely from its bony attachment so that the flattened and distorted nostril may be made to correspond in shape to that on the opposite side.

After making an incision down to the bone the soft tissue can be stripped from this bony attachment with a blunt dissector; this method will minimize bleeding. If, however, hemorrhage is severe, hot sponge pressure will readily control the flow of blood.

The extent to which the lip should be detached from the bone depends upon the width of the cleft; unless this is done to the extent that the parts to be united can be approximated in their new position without tension, one cannot hope for an artistic mouth.

Harelips which have been operated upon without a free undercutting will usually show a flattened nostril and a triangular scar extending downward from it.

Cutting of the Borders of the Cleft to Obtain Symmetry of the Nostrils, an Invisible Scar of the Lip and a Well-Contoured Vermilion Border

This stage of the operation must be done with great care in order to obtain symmetry of the nostril, to avoid a scar and to obtain a continuous and well-formed muco-cutaneous line or red margin. The cutting away the borders of the lip to obtain union of the two segments of the divided lip is not sufficient. While such procedure will close the cleft it will not avoid the formation of a V-shaped notch at the vermilion border, by subsequent cicatrization.

Fig. 9.—Nelaton operation.

Fig. 10.—Grafe operation.

Fig. 11.—Konig operation.

Quite a number of surgeons endeavor to utilize all of the tissue bounding the cleft of lip. This method is suitable when the cleft is not extensive and the margins are quite parallel. The preparation of the borders of the lip depends largely on the degree of the deformity. No one method can be universally followed. The surgeon should rely on his own judgment and plan the incisions that are indicated for each case in order to obtain the best result.

From my own experience I am satisfied that a free removal of tissue on each side of the cleft is not justified; neither do I advocate the other extreme, to utilize all of the tissue bounding the cleft of the lip.

The following methods give some idea of the various forms of operation:

Fig. 12.—Haagedorn operation.

Fig. 13 shows the incisions the author prefers in repairing a single cleft.

When a cleft of the lip is of moderate extent and does not involve all of the lip extending into the nostril, the Nelaton method may be followed. In this operation an incision is made thru the lip above the angle parallel with the defect. The vermilion border then drops downward (see Fig. 9). The lower border of the wound is drawn downward and the sides of the wound sutured. This causes the vermilion border to protrude downward. It is claimed that during healing the shrinkage is sufficient to form a normal-shaped lip. In my experience I find that this does not always happen, so that I have abandoned this method.

The Grafe method gives the lip a

better shape. This operation is performed by making a semicircular incision above the defect (Fig. 10). The first suture is placed at the margin of the vermilion border and the skin, so that the sides approximate normally. This method is quite satisfactory in cases where the notch in the lip is not extensive. If carefully done one can obtain a splendid contour of the vermilion border.

When the cleft in the lip is more extensive, many surgeons follow the Konig

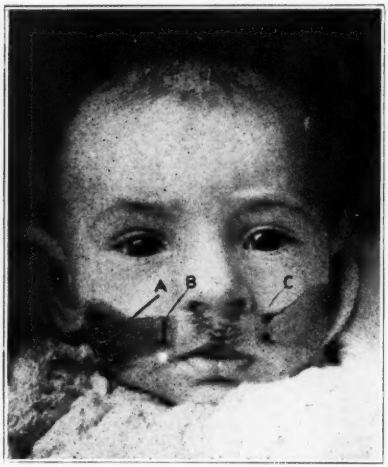


Fig. 14.—Author's method of reinforcing the center sutures: *A*, adhesive tape, *B*, silver wire, *C*, perforated shot.

method. This operation is done by making two vertical incisions in order to cut away the borders of the cleft. Then a slanting incision is made on each side (Fig. 11). By drawing the wound together (Fig. 11-B), and by holding the vermilion borders together and downward and then suturing, a very nice prolabium can be obtained (Fig. 11).

The Haagedorn method is somewhat similar to the Konig method. The vertical incisions are semicircular (Fig. 12-A), and the later incision slanting somewhat downward. Figure 12-B shows the wound as it should be, and Figure 12-C the wound sutured. This operation will give a good-appearing lip;

15 16

Figs. 15 and 16.—Congenital cleft of the lip, alveolar process, and soft palate.

however, in some cases, especially in those cases that have scar tissue following infection, a V-shaped notch will be formed in the vermilion border.

While there are so many methods advocated for the repair of a harelip, I find that no one rule can be followed. In the majority of cases I find the following method giving the best results: This operation is done by making a slight curved incision downward from the nostril, separating the vermilion border

Fig. 17 shows method of immobilizing the fractured bone with an alignment wire to which the anterior teeth were ligated.

from the skin; then making a downward slanting incision on one side toward the cleft, and on the other side a downward slanting incision away from the cleft (Fig. 13-A). Figure 13-B shows the

cut surface, Figure 13-C, the wound sutured. The planning of these incisions so as to provide a fulness of the vermilion border depends on the thickness of the lip, and the size of the cleft. The sutures are inserted in the skin and mucous membrane after the wound is prepared so that the borders will approximate to give the lip the proper form and contour. It is important that the suture be so placed that the raw surfaces will be in contact without any curling or buckling of the edges, neither should there be any bleeding of the raw surfaces. In our experience we find that fine paraffin silk is the ideal suture material. It does not absorb moisture, and is friendly to the tissue.

After the suturing, the lateral tension must be overcome. This is important. Unless the wound is put at rest, one cannot hope for a good result. One should not rely on the skin and mucous membrane sutures to hold the raw surfaces together. Various methods may be used to reinforce these sutures. In our experience we have adopted the following methods:

Adhesive tape is glued to the cheek on each side (Fig. 14). The edges near the lip are turned inward. A strong paraffin silk ligature is then passed thru the tape into the lip midway between the skin and mucous membrane, in the form of a mattress suture; then by tying the loose ends sufficient tension can be brought to bear so that the approximating sutures will not tear out from the sphincter-like action of the orbicularis muscle. This simple method puts the lip at rest. The lip is again washed with 60 per cent alcohol made dry and liquid paraffin sprayed on the lips, so that the sutures are covered with a thin layer of paraffin.

After the lip is closed the sphincter-like action of the orbicularis muscle will continue to mold the alveolar cleft so that its borders approximate and in some cases closure takes place. If, however, the borders fail to unite, I usually cauterize the borders in order to obtain a complete organization of the approximating borders to obtain union. If the patient is at an age when the stripping of the adhesive tape will not cause a narrowing of the alveolar cleft, I close the cleft by producing a green-stick fracture of the alveolar process, thereby preserving the shape of the dental arch. This is best illustrated in the following case:

Patient, female, nine years old; excellent health; had congenital cleft of the lip, alveolar process and soft palate (see Figs. 15 and 16). Notice that the alveolar process is divided between the left central and the rudimentary left lateral. The alveolar process on the right side was turned outward and protruded to such an extent that it caused a distortion in that region. It was necessary to reconstruct the shape of the dental arch before doing anything further. The patient was anesthetized under ether, and incision was made between the right deciduous cuspid and right permanent later. The muco-periosteal flaps were raised and retracted, the exposed bone was cut one-half its thickness by a narrow long fissure bur; than by forcible pressure the protruding alveolar process containing the lateral and two centrals was brought in contact with the alveolar process on the opposite side, thus producing a green-stick fracture. The borders of the cleft were freshened and held together with an orthodontic appliance (Fig. 17). The

Fig. 18 shows result of the operation before and after treatment.

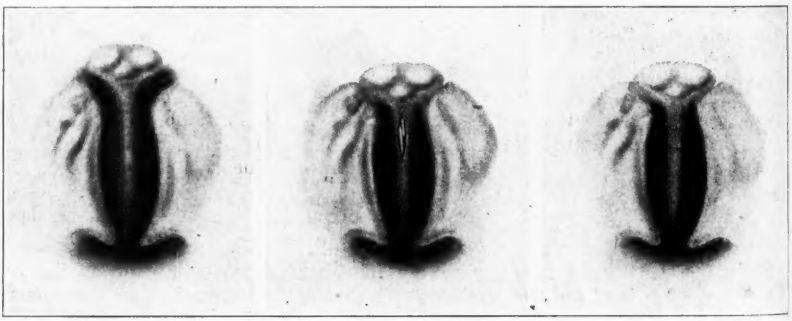
patient's mouth was kept as clean as possible and four weeks later, after union had taken place, the appliance was removed. This operation restored to a fair degree the shape of the dental arch, (Fig. 18), and as a result the cleft of the lip became narrower. When I operated upon the patient the second time for the correction of the lip, I obtained better results than if I had attempted closing the lip before the shape of the dental arch had been restored (Fig. 19).

Fig. 19 shows result after operation.

After the correction of the alveolar cleft and the cleft of the lip, the patient is usually discharged for about six months, at which time the cleft of the palate is closed.

Should there be a double alveolar cleft where the central portion of the os incisivum is displaced forward and attached to the tip of the nose, I usually cut the vomer to allow the septum to overlap when the protruding os incisivum is forced backward. Then by passing wire suture thru the vomer and freshening the approximating surfaces of the borders of the alveolar cleft, good results are obtained (Fig. 20.) The lip then is closed several weeks later.

In cases where the patient is older and the teeth are erupting, I find that cutting of the vomer is not sufficient to force the protruding os incisivum in its new position. In these cases I resort to orthodontic care. Bands with buccal tubing are fitted and cemented to the molar teeth, and alignment wire fitted to the arch to rest on the incisors and passing thru the buccal tubing. To the alignment wire is soldered hooks; rubber bands are then stretched from the



A B C

Fig. 20.—A, drawing of the palatal view to show the double cleft and protruding pre-maxillary; B, the vomer cut so that the pre-maxillary bone could be forced into its normal position; C, the pre-maxillary bone wired in its new position.

buccal tubing to the hooks. These rubber bands are to be replaced daily. After the patient is accustomed to the orthodontia appliance, I operate on the vomer by doing a submucous resection. The orthodontic treatment gradually shifts the protruding mass in its position. The borders are cauterized to promote fusing of the tissue. The lip is then operated on.

If, however, the os incisivum is undeveloped, the teeth decayed, pulp diseased, and there is a chronic inflammatory process going on, I find it advisable to remove the protruding mass. This is done by stripping loose the soft tissue and suturing it across the gap to act as a good stump for restoration with artificial teeth.

In my experience in the repair of alveolar clefts, I find that after having followed the Brophy method closely in operating on these defects I would frequently destroy some of the tooth buds. I have also observed that the end results of this technic by excellent cleft palate operation were similar to my results. The loss of several teeth prevents the normal development of the upper jaw. It has a tendency to start a so-called progressive malocclusion, the upper jaw remaining stunted, leaving the patient after the passing of years with an infantile jaw, called micrognathia.

The lower jaw appears to protrude and the upper jaw is undeveloped. While it is true that many of these cases can be benefited by orthodontic care, orthodontists agree that to accomplish this there must be a sufficient number of teeth to stimulate growth of the jaw for normal development.

By observing Figure 21 it will be noticed that a number of teeth are missing. It is a cast of the upper jaw of a young lad who was operated on for cleft palate in infancy. The parents informed me that the patient was two months of age when the operation was performed, that wire was passed thru the jaw and then thru lead plates on each side of the arch, that these wires were twisted until the front of the cleft was closed, and that since the operation nothing was done to close the remaining part of the palatal cleft.

The upper arch appeared undeveloped and the lower jaw protruded. This inharmonious relation of the arches gave the boy a rather unpleasing appearance. The bicuspids, left

Fig. 21 shows loss of teeth caused by passing silver wire thru the jaw for the closing of a cleft of the alveolar process. The jaw is undeveloped and a number of permanent teeth are lost.

lateral and the right cuspid were missing. The other teeth were deciduous. The cause for the missing teeth, no doubt, was due to the operation in the attempt to close the cleft. While this may not happen by operators who claim that the passing of wire thru the jaw to repair a cleft does not destroy the tooth buds, I am of the opinion that this method of operating for the repair of the cleft will destroy tooth buds in the majority of operations that are done in this way. The loss of a number of permanent teeth in a contracted and

undeveloped upper arch is difficult to correct by orthodontic care.

Such cases have been treated by us for a number of years. While the improvement was remarkable, we can never hope for results as beautiful and effective as when the teeth are not missing. Let us compare this care with that of Figure 22. This shows the result which can be achieved in developing the upper jaw, restoring the forces of mastication, improving the facial lines, and enlarging the nasal channels. In this case there were sufficient number of teeth to fit the proper appliance to obtain the right results. The object of comparing these two cases is to impress

Fig. 22 shows a contracted upper arch with the teeth in malocclusion, and the result after orthodontic treatment.

upon operators the importance of preserving the deciduous and permanent teeth when operating upon cleft palate cases in order to permit further care, if necessary thru orthodontic means.

After the alveolar cleft and harelip is repaired, the next step is the closing of the palatal cleft. Before attempting to repair a cleft of the hard and soft palate, the operator should be well informed on the advantage and disadvantage of surgical care or the substituting of an obturator for the restoration of function.

I have observed in my experience a large number of cases where surgery was resorted to for the correction of a cleft palate, with the end result anything but satisfactory. While the opening was closed, the soft palate was short and immovable from the large amount of scar tissue so that function was impossible. In other cases I have observed patients wearing an artificial palate and velum which did little or no good to improve function.

I do not consider that a set of unalterable regulations can be established as to whether a mechanical substitute or surgical correction is best suited for the patient, but I do know that unless one has had a training in correcting a

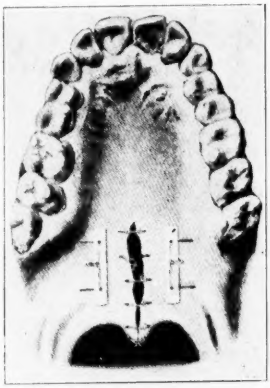


Fig. 23 shows the ligatures cutting into the soft tissues. This form of reinforcing the center sutures is not practical.

cleft palate by mechanical restoration and surgical repair he cannot be in a position to judge what is best fitted for the patient's welfare.

The oral surgeon who manifests a desire to give his patient that which is best, cannot ignore the value of an artificial palate. In cases where surgical correction has its limitations, the crude methods that have been employed by a large number of surgeons to close a cleft palate by making long lateral incisions, or the reflected flap method, may and frequently do close the cleft. The result as far as function goes must be considered a failure. Unless one is satisfied that there is a sufficient amount

of tissue to bridge over the gap and the soft palate can be lengthened to establish a functionating velum, then it is far better to advise the patient to wear an artificial palate.

For a number of years I followed the methods of the world's best oral surgeons for the surgical repair of a cleft of the hard and soft palate. In some the results were excellent, in some, a partial failure, and in a large number, a complete failure. While I could usually approximate the borders of the cleft after freeing of the mucoperiosteal flaps, without making lateral incisions, I found it a difficult task to overcome lateral tension. If I made lateral incisions, scar tissue would fill in the lateral wounds and the result would be a short and stiff drum-like palate. While the cleft was usually closed I felt that my results and the cases operated on by others were not as they should be.

Ten years ago I adopted a new method for the relief of lateral tension which would overcome the necessity of making lateral incisions. In 1916 I reported my results before the Kansas City Dental Society. Since that time I have applied this method in every case for the repair of a cleft of the hard and soft palate with results far better than any method I had followed heretofore.

In order to fully appreciate my method in the relief of lateral tension in cleft palate operations, I will describe the technic of combined uranoplasty and staphylorrhaphy. The method universally employed is Langenbeck's, which consists of the following steps: (1) freeing of mucoperiosteal flaps; (2) freshening the edges of the cleft; (3) placing and tying of sutures; (4) relief of lateral tension.

Freeing of the mucoperiosteal flaps.—This procedure is accomplished by cutting the mucous membrane along the entire borders of the cleft and separating the soft tissue by periosteal elevators and cutting the tissue loose from the distal surface of the horizontal plates of the palate bone. This should be done with great care in order to prevent tearing or lacerating, which may seriously impair nutrition. Naturally this brings on considerable hemorrhage, which can be stopped by firmly pressing a gauze sponge against the bleeding surface. It is not always possible to avoid wounding the anterior palatine and especially the posterior palatine artery. Should one of the vessels be nicked it will cause severe and prolonged hemorrhage. It is therefore better to completely divide the vessel so that it will contract as it ends, thereby overcoming protracted bleeding.

Freshening the edges of the cleft.—This can best be accomplished by grasping the uvula on one side with a catch forcep and putting tension on the soft tissues, then with a very sharp thin-bladed knife cut a thin marginal strip along the entire flap from the uvula to the apex of the cleft. This same procedure is to be carried out on the opposite side. The freshened surface should be cut square with the flap tissue. A beveled surface is conducive to failure. If the raw surfaces are cut square, it is an easy matter to bring them together in close apposition, which will enable rapid union during the healing period. In cases where there seems to be a shortage of tissue in the soft palate I prefer to split the border of the velum about one-eighth of an inch and then unite the raw surfaces.

Placing and tying of sutures.—Various kinds of suture material have been adopted for holding the pared edges together, such as silk, horsehair, linen, catgut, wire, etc. Personally I do not believe that the difference in value of the above-named suture materials is of any great consequence, providing the operator does not depend upon the same to overcome lateral tension. Sir William Ferguson, in 1844, recognized that the tension on the ligatures frequently invited failure, either thru their cutting out or by shutting off the circulation,

thereby bringing on starvation necrosis and infection. To overcome this tension Ferguson divided the levator palati, the palatoglossi, and the palatopharyngeal muscles. In 1860 Dr. Agnew believed that the tensor palati muscles were responsible by pulling the newly approximated surfaces on the soft palate apart, thus causing the sutures to pull out. Therefore he advocated making an incision close to the hamular process of the sphenoid bone, and in this way overcoming tension. For a long time these methods were extensively adopted by operators in this and foreign countries.

24 25 26

Figs 24, 25, 26.—Fig. 24 shows a cleft of the hard and soft palate; Fig. 25 shows the author's plates in position before wires are tightened; Fig. 26 shows the author's plates in position and the cleft closed.

The end results were not satisfactory. This was pointed out in a paper by T. W. Brophy in 1901 in which he says: "The formation of cicatrices following incision renders the soft palate thick and unyielding, so that its function is performed imperfectly." Dr. Brophy finds it unnecessary to cut the muscles on either side; it was he who introduced the application of lead plates. The advantages claimed for these plates are to render the palate inflexible and the prevention of the cutting out of the sutures. Dr. Blair reports that he has discontinued the use of lead plates as a retention device because they occasionally caused sloughing, in spite of every care; he depends entirely upon the sufficient freeing of the flaps. In my experiences I have never found that the plates cause sloughing, but that they did not prevent the suture from cutting (see Fig. 23). They are, however, of a distinct advantage in rendering the palate inflexible. In order to prevent the cutting of the suture thru the soft tissue I have devised a new tension plate which will prevent the suture material from cutting out and at the same time relieve the tension as well as render the palatal tissues inflexible. These plates are made from non-corrosive metal B. I. B. American gauge No. 22, in various sizes.

The object of these plates is to prevent the cutting out of the wire ligature which frequently happens with the Brophy plates. In order to fit these plates it is necessary to make a small incision near the gingival border of the last molar; care must be exercised not to cut the palatine artery. (The operator must take into consideration the degree of the cleft, the position of the blood vessels and the size of plate that best suits his purpose). The incision should be of sufficient length to permit the flange of the plate to enter and lie between the palatal bone and soft tissue. Previous to fitting these plates it is

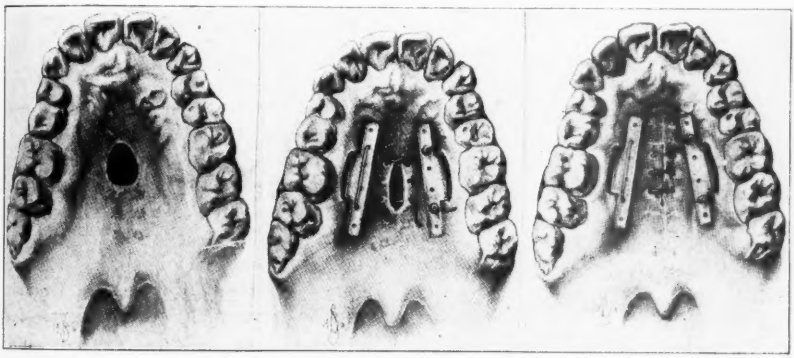
necessary to pass silver wire (American gauge No. 24) thru the mucoperiosteal flaps and then thru the holes in the plates. The ends of the wire are then passed thru perforated lead shot and made tense by pulling the wire and crushing the shot after the borders of the flaps can be approximated without tension. After this is done I denude the border of the cleft and then place and tie the coaptating sutures after the McCurdy method.

While to the beginner it is rather a difficult procedure to properly fit these plates he can, with a little patience, soon master the technic of this simple procedure as an aid in obtaining uniform anatomical, as well as physiological results.

Figure 24 illustrates the cleft of the hard and soft palate; Figure 25 shows the same case with the plates in position; Figure 26 shows the same case and the operation completed. These plates are now relieving the center ligatures so that healing can take place without tension.

Figure 27 illustrates the so called "button-hole" opening in the center of the palate. This form of opening usually is the end result of an attempt to close the hard and soft palate. Figures 28 and 29 show the advantage of using the author's tenison plates for closing the opening.

A progressive scientific man must first of all be one hundred per cent honest and must present his ideas in their true genuine light. One should be progressive, but one must also be revolutionary. When it comes to applying anything new to patients, intelligent conservatism in indispensable, the old methods must be discarded only when experimental investigation and clinical experience, presented by men who are qualified to discriminate, have shown the superiority of the new over the old. A new revolutionary medical invention should be accepted with a most painstaking, careful and exhaustive control, which obviously requires long time and the co-operation of many workers.



27 28 29

Figs. 27, 28, 29.—Fig. 27, button hole opening; Figs. 28 and 29, advantages of using author's tension plates for closing the opening.

Reminiscences of Forty-five Years in Dentistry

By C. N. JOHNSON, M.A., L.D.S., D.D.S., M.D.S., F.A.C.D., Chicago, Illinois

IV

BY REASON of my period of indentureship with a dentist I was privileged to complete my college course and write for my diploma in one year provided I could get up the work. The course in dental schools consisted of two years at that time, and the problem of condensing the two years' work in one was rather formidable. But certain financial reverses which had overtaken my family at this period made it imperative that this should be done if humanly possible and so in the fall of 1880 I entered the Royal College of Dental Surgeons of Ontario, in the city of Toronto, on money borrowed for the purpose.

I shall never forget the first few days I spent in that institution. It was the most depressing experience I had ever encountered up to that time, and I have ever since had the widest charity for a student just beginning his college course. In the first place, most of the boys were strangers to me, and yet it was not from the boys that I received my discouragement. Boys just naturally grow together in a community of interest when assembled for a session in college, and this class was no exception. I got my chief blow from a man whom I afterward learned to love and revere, and whose memory I cherish today in a manner akin to filial affection. But how he did terrify me when I first knew him!

Our three chief professors—in fact the only teachers from whom we received lectures were J. B. Willmott, Luke Teskey, and W. T. Stuart, and three more capable men for the work it would be difficult to find. All have succumbed to the ultimate inevitable, and laid down their work for younger hands to carry on, but they left an impress on dental education in Ontario which is accountable in large degree for the splendid progress that has ever since been made. Dr. Willmott was the Dean, and to him fell the duty of delivering the first lecture. It was during that lecture that I received the body blow that nearly knocked me out. Why he took the course he did I have never been able to understand, but he spent most of the hour dilating upon the difficulties of the coming session, and wound up by looking pointedly at me and declaring that a one-year man could never hope to get thru. There was only one other one-year man beside myself, so even if he had not looked at me the allusion was rather pointed. There was I, a poor boy, going to college on borrowed money, and informed before the whole class that I could not get thru. Possibly it was the

dean's idea to put me on my mettle and spur me to my best efforts—in any event I am going to attribute it to that; but the result was to give me a most wretched night, and start me off on my college course under the greatest depression. I knew I was legally entitled to be graduated if I could get up the work, and I made "a virtue of necessity" and plunged into my studies.

I greatly fear that this early episode of my student days has led me to err conversely on many occasions in my treatment of students since I became a teacher myself. No matter what the character of the student may be, nor what his attitude is toward his work, I have never been able to find it in my heart to say anything but a word of encouragement. Possibly in many instances it might have been better for the student if I had done otherwise.

My chief difficulty in college was, of course, with the theory. During my indentureship, while I tried to study books, I got almost no benefit from them that could be applied in any way to my college course. It needed the personal contact with the teachers to clarify and render intelligible the things taught in the books; and this very idea is amply borne out in another relation of our professional life. We often hear men make the statement, as an excuse for not attending dental societies, that they can read the proceedings in the journals, and get all the benefit therefrom; but it cannot be done. There is a stimulus and clarity in the personal touch with our fellowmen that can never be registered on the printed page. It is the difference between talking to a friend, and writing him a letter.

So it required the interpretation of the professors to make clear the ideas advanced in the books, and even then much of it was difficult enough to master. When it came to the practical work I could "run rings around" most of the boys on account of my previous practice, so this part of the requirement gave me little trouble.

I got my first word of encouragement from a fellow-student so far as my theoretical studies were concerned. He was a star student in his Senior year, articled with the president of the examining board, and looked upon as the leader of his class. For some unaccountable reason he began to take an interest in me and finally invited me, with my roommate—a Junior—to go to his room one evening to quiz. We were in the intricacies of anatomy, and he asked me to describe the petrous portion of the temporal bone. When I had finished he looked at me admiringly and said: "Johnson, you are a horse for study. You won't have any trouble getting thru." I could have hugged that boy for very joy, because up to that time it had been a dull, heavy plod. No one can estimate the wondrous effect of a word of encouragement to a struggling student—to any one struggling, for that matter. That chance remark of my fellow-student put the very breath of life in me, and I went at my work with a new light in my eye, and a new resolve in my heart. A chance remark on my ability to recite a bit of anatomy turned the tide of my student life; and ah me—ah my—I could not recall today one single landmark on that blessed bone—gone from me as completely as if I had never pored over the immortal *Gray* well toward midnight with the aid of a kerosene lamp.

Then Dean Willmott began to do things which brought a glow of warmth to my heart. It must have become apparent to him that I was desperately in earnest with my studies, because of the close attention I paid to every word

of his lectures. When I entered the school I had taken a seat to one side of the lecture room and well to the rear, so that I should not encroach on the rights or conveniences of the boys who had attended the year before. (It may be necessary to state that in those days the Seniors and Juniors all took the same lectures).

The session was not very old when one day the Dean on entering the lecture room cast his eye over the class before he began his lecture, and said in a most kindly way: "Johnson, that seat you occupy is not a very good one. You had better come up and take this one," indicating a seat that chanced to be vacant in the best part of the room. I was so confused for a moment that I fear I forgot to thank the Dean, my sole reflection to myself being, "Now this bit of pointed favoritism will queer me with the boys." But those boys were not of that type. As I look back over the personnel of that class it warms my heart thru and thru. There never assembled a better hearted lot of fellows, nor a body of boys more full of fun and mischief, and the very essence of life. What would I not give today to get those dear chaps around a table at dinner, and listen to their stories and hear their songs! It would be greater entertainment than the grandest grand opera. But alas! Many are scattered to the four winds and a goodly number of them have "checked out" for the voyage that knows no return, leaving behind them the most precious memories of the dear old days when we sat together on the benches at the corner of Shuter and Bond streets.

One of the "live wires" of the class and one of the best singers was S. S. Davidson of Ottawa—dear old Sam, still practicing in Ottawa, and still warming the hearts of his friends by his singing and good cheer. I can see that precious rascal yet lolling back in his chair and rolling out in sonorous waves, "On the old Ontario Strand," and other stirring songs.

In 1914—more than thirty years later—I was in Europe with my family when the war broke out. The problem of getting home was a very serious one, and there was a general clamor for accommodations. The ship on which I had engaged return passage was commandeered, and the outlook was disheartening. In the Hotel Cecil one day I chanced to meet my old friend Sam Davidson. We were soon in the midst of reminiscences of the days back at the R. C. D. S., and had almost forgotten the war when suddenly Sam said: "Say old man how are you going to get home?" "Sam" said I, "if you can answer that you can do better than you could when the professors asked you a question as we sat together on the benches back on the corner of Shuter and Bond." Sam's face lightened up into one of those characteristic smiles of his and he said: "Well now, we'll see, maybe I can fix it up for you. I sail on the Royal George for Montreal, August 12, and I have a relative who is very close to the London manager of the company." Suffice it to say that Sam secured passage for my family and myself at a time when literally thousands of people were clamoring in vain for accommodation. There is something so very precious in the friendships formed during one's college days that there is no way of estimating it, and the earlier the boys of today realize this fact the greater happiness they will get out of their professional careers.

I recall in particular one lecture of that course that left a lasting impression upon me. It was delivered by the late Professor Teskey, a man who usually

had his subject well in hand. It was on that most fascinating topic physiology, and Dr. Teskey lost himself in his enthusiasm, apparently forgetting that he was teaching students, and giving rein to his splendid imagination in contemplating the miracle of some of the life forces. I do not recall the precise aspect of the subject, nor do I remember the points he made, but I shall never forget the masterly manner in which he handled the topic nor the glow of earnest conviction behind his utterances. It was the spirit of the thing, the essence of it which left its imprint on the class, and it was of infinitely greater value than all the dry-as-dust information he might otherwise have imparted. I have often thought that the chief benefit to a class was not the mere technical knowledge which a teacher imparts, but the spirit he instils into them, the inspiration he gives them toward the higher and better things of life, and the influence he exerts in his daily intercourse and his example. A teacher sometimes makes the mistake of assuming that his only relationship to his students is represented by his ability to impart technical information, and that when he has done that his obligation is fulfilled. This is a false interpretation of the true function of a teacher, and it accounts for much of the inefficiency we see illustrated in our educational work. Boys are in their formative period when they are attending college, and they are amenable to all good influences and sometimes susceptible to bad influences. It is therefore a sacred duty for every teacher to try to exert the best influence of which he is capable upon every boy with whom he comes in contact, and in the ultimate the good he may do in this way will far outweigh in value all the benefit to be gained from his scholastic instruction. This does not imply that he must continually preach to the boys—nor in fact that he must preach at all—but that his daily life shall be of such a character that they are unerringly led into lines of high endeavor by the sheer force of his example.

(To be continued)

THE JOURNAL of the NATIONAL DENTAL ASSOCIATION

Entered as second-class matter, March 22, 1915, at the Post Office at Huntington, Indiana, under the Act of August 24, 1912. Published Monthly.

Editor and General Manager,
OTTO U. KING, D.D.S., F.A.C.D., 127 N. Dearborn St., Chicago, Illinois.
Associate Editors,
THOMAS P. HINMAN, D.D.S., F.A.C.D., Atlanta, Ga.
HARVEY J. BURKHART, D.D.S., LL.D., F.A.C.D., Rochester, N. Y.
THOMAS B. HARTZELL, D.M.D., M.D., F.A.C.D., Minneapolis, Minn.

All expressions of opinion and all statements of supposed facts are published on the authority of the writer over whose signature they appear and are not to be regarded as expressing the views of the National Dental Association, unless such statements or opinions have been adopted by vote of the Association.

MANUSCRIPTS: Manuscripts should be typewritten, double-spaced, and the original, not the carbon copy, submitted. We cannot promise to return unused manuscript and used manuscript is not returned. Requests for reprints should be made at the time of forwarding article. We reserve the right to accept or reject any manuscript for publication. Articles are accepted for publication on condition that they are contributed solely to this journal.

SUBSCRIPTION included in the annual membership dues.

SUBSCRIPTION, $2.00 a year, in advance, to non-members, living in all parts of the United States or its possessions. Canada, $3.00. Foreign countries, $3.00. Single copies, 25 cents.

ADVERTISEMENTS accepted only from reliable firms. Fraudulent and misleading advertisements barred.

IN CHANGES of ADDRESS both the old and new address must be given.

JOURNALS are not sent beyond the subscription period.

VOL. 9 APRIL, 1922 No. 4

Editorial Department

DENTAL ETHICS

It would sometimes seem as if dentists had forgotten that there is supposed to be a line of demarkation between the practice of a profession and the pursuit of a commercial calling. We have a written code of ethics which states more or less specifically just what a dentist may or may not do if he wishes to attain to professional status. Every man who joins a dental society subscribes to this code and is supposed to abide by its provisions. But this is not always done to the exact

letter, because dentists are human, the same as other people, and therefore subject to the same limitations. Some of them err thru lack of discriminating judgment, while a few deliberately err thru a perversion of their obligation. They sail as closely as they can to the precise wording of the code without the slightest regard for the spirit of the code. These men are not constructively uplifting to the profession, but are passively disintegrating to it.

A profession is judged by the impression made upon the world by its members and a man whose mind is so constituted that he is always seeking a subversion of his ethical obligations never makes a fortunate impression on those with whom he comes in contact.

A direct violation of the letter of the code is not the only means of bringing the profession into disrepute. In fact the most subtle undermining of true professionalism is found in those practices which are not tangibly amenable to disciplinary treatment on the part of dental society officials. Any exploitation of the people whereby they are imposed upon or misled thru misrepresentation of facts, or whereby their fears are played upon to extort money without justification is as truly unethical as are display advertisements in the daily press and yet there is nothing in the written code to specifically meet these cases. To play upon the credulity or ignorance of patients to their detriment, whether financial or physical, is as direct a violation of ethical principles as can be imagined, but no one article in the code seems to cover this point.

It is impossible to so word a code that it will incorporate every conceivable abuse, and there is much which in the very nature of things must be left to the individual honor of the one who subscribes to the code. After all, ethical conduct is a matter of personal conscience, and yet the written code has done incalculable good in acting as a guide and giving a tangible set of rules to govern those whose minds are not quite clear as to what they should or should not do.

When one studies the ideals of the sturdy old pioneers who placed the profession of dentistry on its feet and gave it a professional status in the eyes of the world, one is impressed with the dignity and loftiness of their ethical bearing. In their attitude toward each other and toward the people they served it is difficult to imagine them doing many of the things which today form the routine of men who pose as ethical. It will do us little harm to hark back occasionally to the idealism of some of these men. Take for instance the names of men no farther back than Garretson, James Truman, Northrup, Taft, McKellops, Webb, Cushing, Black and hundreds of others who might be mentioned—can anyone who knew them imagine that for one moment

these men could ever be found posing in a false light before their patients for the sake of making an impression on them, or in any way misrepresenting facts? And yet men who consider themselves ethical are doing this very thing today.

It is no excuse for men to argue that it is the tendency of the age. Professional men should hold themselves above any such tendencies. If we are to attain to our full stature in the professional world we must consecrate ourselves again and again to the observance of such principles as are embodied in the spirit as well as the letter of the ethical code, and we must so live our professional lives that our example before men shall mark us as worthy of the respect and even the veneration of those with whom we come in contact. In no other way shall we maintain a true professional status or come fully into the splendid heritage left us by the fathers of organized dentistry.

THE EARLIEST MAN AND THE LATEST DISEASE

The newest contribution to the history of human evolution, the Rhodesian skull, seems to be one of the most important finds yet made. It was obtained in a mine in southern Rhodesia along with some other human bones and very crude flint and quartz instruments; and, altho in some features the most primitive of early human skulls, in others it has many points of resemblance to or even identity with the skull of modern man. The supraorbital region is massive and gorilla-like, and the cranium is very flat on top; but the posterior portion is so large that the total capacity is about as great as that of a recent human skull. On the other hand, the massive muscle attachment ridges are of the most primitive type. The palate is well arched, there is great length of face, and the wisdom tooth is reduced in size as in modern man, a feature not found in other fossil skulls. In contrast to the Neanderthal man, who is supposed to have walked in a crouching position because of his curved femur, the Rhodesian man had a straight leg, wherefore it has been stated that this specimen represents the direct ancestors of modern man, the Neanderthal man representing a branching off from the main ancestral tree. For the medical man this new specimen has one particularly interesting feature, the presence of unmistakable evidence of dental caries and even of abscesses at the roots of the teeth. In discussing the subject of paleopathology, a few weeks ago, we commented on the fact that in ancient Egypt dental disease and arthritis deformans were even more prevalent than they are now. The Egyptian mummies are chronologically recent, as compared with the Rhodesian man. There surely can be little justification

in attributing dental caries and alveolar abscesses to modern civilization, overcooking foods or too much candy, in view of the testimony of our earliest known ancestor.—*Jour. Amer. Med. Assoc.*, Vol. 78, No. 8.

A LETTER TO OUR ADVERTISERS

GENTLEMEN:

The *May issue of the Journal* will go to 10,000 new subscribers. Thirty-two extra pages will be run, or a total of eight million pages. Two carloads of paper will be used at a cost of $8,500.00. What an unusual opportunity this offers to our advertisers!

The *May issue of the Journal* will be known as the *Los Angeles Number*. It will contain the complete program of the great meeting, including titles of all the papers with the names of the essayists and the discussers, the clinics and clinicians, announcements of the special dental trains, of railroad and hotel rates, of the meetings of other societies and fraternities, and of the big dental health exhibit, together with a list of all exhibitors. This issue of the *Journal* will be a complete encyclopedia of the meeting.

The *May issue of the Journal* will contain illustrations of all the officers and committeemen, as well as western scenes. We have secured an artist to prepare a cover in colors, which will symbolize Southern California.

The *May issue of the Journal* will go to practically every dentist (42,000) in the United States. The *Journal* itself will be of such a high standard from mechanical and literary standpoints that it will establish a new high-water mark in dental literature.

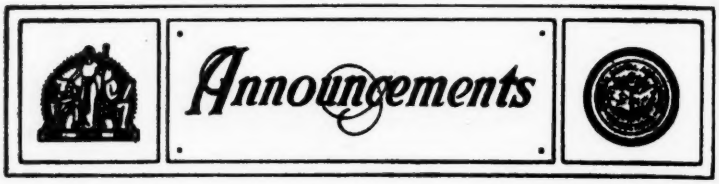
We are offering a special flat rate per page for new or increased advertising business for this issue.

Very truly yours,

(*Signed*) OTTO U. KING,

Editor and Business Manager.

It may seem presumptuous, or perhaps unnecessary, for us to call the attention of our readers to the advertising work, but there are some members of our Association who do not seem to appreciate fully the effort we are making to protect their interests by keeping them posted concerning trustworthy firms and trustworthy products. Our advertising pages contain no announcements concerning preparations that are not thoroly trustworthy. We invite patronage of the advertisers not alone because the advertisers are worthy of patronage, but because the advertising and the income it brings enable us to print a larger and better *Journal*.



CALENDAR OF MEETINGS

NATIONAL SOCIETIES

National Dental Association, July 17-21, 1922, Ambassador Hotel, Los Angeles, Cal. Otto U. King, Secretary, 127 N. Dearborn St., Chicago, Ill.

National Society of Denture Prosthetists, July 3-15, Dental Department, University of Southern California, Los Angeles, Cal. E. B. Owen, Secretary, 335 Frisco Bldg., St. Louis, Mo.

National Association of Dental Examiners, July 17 and 18, Ambassador Hotel, Los Angeles, Cal.

National Association of Dental Faculties, July 13, 14, 15, Hotel Clark, Los Angeles, Cal.

National Dental Sorority, July 17, Ambassador Hotel, Los Angeles, Cal.

American Dental Library and Museum Association, July 17, Ambassador Hotel, Los Angeles, Cal.

American Society of Oral Surgeons and Exodontists, July 11-14, Hotel Alexandria, Los Angeles, Cal.

American Society of Dental Radiographers, July 19 and 20, Ambassador Hotel, Los Angeles, Cal. Martin Dewey, Secretary, 501 Fifth Ave., New York, N. Y.

Association of Military Dental Surgeons, July 18, Los Angeles, Cal.

American Academy of Periodontology, July 10, 11, 1922, Drake Hotel, Chicago, Ill. J. Herbert Wood, Secretary, Cleveland, Ohio.

American Society of Orthodonists, April 24, 25, 26, 1922, Edgewater Beach Hotel, Chicago, Ill. Ralph Waldron, Secretary.

American Dental Society of Europe, July 28-31, London, England. William A. Spring, President, 8 W. 40th St., New York, N. Y. F. W. Fleming, Secretary, 13 Queen Anne St., London.

STATE SOCIETIES

April

Alabama, at Birmingham (11, 12, 13).
Connecticut, at New Haven (20, 21, 22).
Kentucky, at Louisville (10, 11, 12).
Michigan, at Detroit (4, 5, 6).
Mississippi, at Meridian (18, 19, 20).
Pennsylvania, at Pittsburgh (11, 12, 13).
Tri-State—Oklahoma, Kansas and Missouri, at Kansas City, Missouri (10-15).
West Virginia, at Fairmont (10, 11, 12).

May

Illinois, at Springfield (9, 10, 11).
Indiana, at Indianapolis (15, 16, 17, 18).
Iowa, at Des Moines (2, 3, 4).
Louisiana, at Shreveport, (8, 9, 10).
Maryland, at Baltimore (2, 3, 4).
Massachusetts, Worcester (2, 3, 4).
Nebraska, at Lincoln.
New Jersey, at Trenton (3, 4, 5).
New York, at Rochester, (11 12, 13).
North Dakota, at Fargo.
South Dakota, at Sioux Falls (9, 10, 11).
Tennessee, at Memphis (8, 9, 10, 11).

June

California (Southern), at Los Angeles.
Colorado, at Colorado Springs (15, 16, 17).
Georgia, at Atlanta (14, 15, 16).
New Hampshire, at The Wiers (26, 27, 28).
New Mexico, at Albuquerque (26, 27, 28).
North Carolina, at Wrightsville Beach (12, 13, 14).
South Carolina at Georgetown (13, 14, 15).
Utah, at Salt Lake City (19-24).
Wyoming, at Sheridan (20, 21, 22).

July

Wisconsin, at Milwaukee (11, 12, 13).

August

Washington, at Seattle (2-5).

September

Delaware, at Wilmington (14).

October

Virginia, at Richmond (17-20).

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham Dental College, Birmingham, June 19. Secretary, H. Clay Hassell, 616 Twenty-second Ave., Tuscaloosa.

Arkansas, at Hotel Marion, Little Rock, June 19-21. Secretary, H. J. Crume, Wilson Bldg., El Dorado.

California, at College of Physicians and Surgeons, San Francisco, May 20, and at the College of Dentistry, University of Southern California, Los Angeles, June 17, Secretary, C. A. Herrick, 133 Geary St., San Francisco.

Connecticut, at Hartford, June 22-24. Recorder, Robert H. W. Strang, 886 Main St., Bridgeport.

Colorado, at Denver, June 6. Secretary, William H. Flint, Littleton.

Florida, at Jacksonville, June 7, 8, 9, 10. Secretary, R. P. Taylor, Jacksonville.

Idaho, at Boise, Bureau of License, January 10, and July 11, 1922. Paul Davis, Director, Bureau of License, Boise.

Indiana, at Indianapolis, June 12-17. H. C. McKittrick. Secretary, 1006 I. O. O. F. Building, Indianapolis.

Iowa, at College of Dentistry, Iowa City, May 29. Secretary, C. B. Miller, 726 Fleming Bldg., Des Moines.

Kansas, June 19-23, at Wichita, G. F. Ambrose, Secretary, El Dorado.

Maryland, at University of Maryland, Baltimore, June 7, 8 and 9. Secretary F. F. Drew, 701 N. Howard St., Baltimore.

Michigan, at Dental College, Ann Arbor, June 5-11. Secretary, E. O. Gillespie, 745 David Whitney Building, Detroit.

Mississippi, Senate Chamber, State Capitol Building, Jackson, June 20. B. J. Marshall, Secretary, Marks.

New Jersey, at Trenton, June 26-30. Secretary, John C. Forsyth, 429 E. State St., Trenton.

North Carolina, at Wrightsville Beach, Wilmington, June 8. Secretary, F. L. Hunt, Asheville.

Oklahoma, at Oklahoma City, June 26. L. M. Doss, Secretary, American National Bank Building, Oklahoma City.

Pennsylvania, at Pittsburgh and Philadelphia, June 21-24. Secretary, Alexander H. Reynolds, 4630 Chester Ave., Philadelphia, Pa.

Texas, at Dallas, June 19-22. R. L. Rogers Secretary, Amarillo.

Virginia, at Richmond, June 13. Secretary, J. P. Stiff, Fredericksburg.

West Virginia, at Wheeling, June 27. Secretary, R. Mason Hite, Mannington.

Wisconsin, June 19-24. J. L. Blish, Secretary, Fond du Lac.

STUDY CLUBS AND OTHER SOCIETIES

Alumni Association of the Baltimore College of Dental Surgery, May 30 to June 1, 1922, Emerson Hotel, Baltimore, Maryland. Secretary Norval H. McDonald, 904 N. Charles St., Baltimore, Maryland.

Alumni Society of the Dewey School of Orthodontia, April 27, 28, Edgewater Beach Hotel, Chicago, Illinois. Secretary, George F. Burke, 741-43 David Whitney Bldg., Detroit, Mich.

Dental Hygienist Association of the State of New York, May 12 and 13, Rochester Dental Dispensary.

Northern Ohio Dental Association, June 5, 6, 7, Hotel Statler, Cleveland, Secretary, George B. Smith, Fremont, Ohio.

Philadelphia Dental College, April 19, Secretary, William H. Magann, 1222 N. Eighteenth St., Philadelphia.

INDIANA STATE DENTAL ASSOCIATION

The Indiana State Dental Association will hold its sixty-fourth annual meeting at Indianapolis, May 15, 16, 17, 18, 1922, at the Claypool Hotel. All ethical dentists are cordially invited to attend. F. L. Gravis, Martinsville, Indiana, is master of exhibits.

For further information, write to

A. J. KIMM, *Secretary*
704-5 Citizens Bank Bldg., Evansville, Ind.

ILLINOIS STATE DENTAL SOCIETY

The fifty-eighth annual meeting of the Illinois State Dental Society will be held in Springfield, Illinois, May 9, 10 and 11, 1922.

The officers of the society are as follows: president, Frederick B. Noyes, Peoples Gas Bldg., Chicago; vice-president, R. H. Daniels, 909 Lehmann Bldg., Peoria; president-elect, E. F. Hazell, 608 E. Capitol Ave., Springfield; secretary, Arthur G. Smith, 511 Central National Bank Building, Peoria; treasurer, T. L. Grisamore, 29 E. Madison St., Chicago; librarian, T. E. Turner, 25 E. Washington St., Chicago.

ARTHUR G. SMITH, *Secretary*
511 Central National Bank Bld., Peoria, Ill.

VIRGINIA STATE DENTAL ASSOCIATION

The fifty-third annual meeting of the Virginia State Dental Association will be held in Richmond, October 17 to 20.

HARRY BEAR, *Secretary*
Richmond, Va.

SOUTH DAKOTA STATE DENTAL SOCIETY

The fortieth annual session of the South Dakota State Dental Society will be held at Sioux Falls, South Dakota, May 9, 10, 11. Rupert E. Hall of Chicago, and C. O. Simpson of St. Louis, will give clinics, and Otto U. King, secretary-editor of the National Dental Association will present two papers. All members of dental societies in good standings are invited. Bring your membership card.

E. W. ELMEN, *Secretary*
Sioux Falls, S. D.

SOUTH CAROLINA STATE DENTAL SOCIETY

The South Carolina State Dental Association will hold its annual meeting at Georgetown, South Carolina, June 13, 14 and 15, 1922.

ERNEST C. DYE, *Secretary*
Mansion House, Greenville, S. C.

MASSACHUSETTS DENTAL SOCIETY

The fifty-eighth annual meeting will be held in Worcester, Massachusetts, at Mechanics Hall, 321 Main Street, May 2, 3 and 4. A cordial invitation is extended to all members of recognized dental societies.

W. VERNON RYDER, *Secretary*
175 Newbury St., Boston, Mass.

SOUTHWESTERN DENTAL SOCIETY

The Southwestern Dental Society which includes western Texas, New Mexico, and Arizona, will hold its next meeting the week prior to the meeting of the National Dental Association. Those contemplating going to Los Angeles by way of El Paso will find many things of interest to justify their stopping off and attending the meeting of the Southwestern Dental Society.

The committee is confident that Jaurez (just across the Rio Grande from El Paso), offers many things of unusual interest to Americans.

The Secretary and the Southwestern Dental Society desire to have as many visiting dentists as can possibly accept their hospitality. He would like to fill out the program and resorts to these means of extending the opportunity to some of our brothers from the North and East to have a good time and also present matters of interest to the dentists of West Texas, New Mexico, and Arizona.

If you expect to go to California by way of El Paso, by all means communicate with the undersigned. July 11, 12, 13, and 14, are the dates of the Southwestern meeting.

J. J. CLARKE, *Secretary*
Artesia, N. M.

ARKANSAS STATE BOARD OF DENTAL EXAMINERS

The Arkansas State Board of Dental Examiners will hold its regular meeting for the purpose of examining applicants June 19, 20, 21. Hotel Marion, Little Rock, Arkansas.

Applications may be secured by addressing

H. J. CRUME, *Secretary*
Wilson Bldg., El Dorado, Ark.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

The next examination for a license to practice dentistry and as a dental hygienist in the state of California will be held in the city of San Francisco, at the College of Physicians and Surgeons, May 20, at 9:30 A. M. This examination will be followed by an examination to be held in the city of Los Angeles, at the College of Dentistry, University of Southern California, June 17, at 9:30 A. M.

For further information, address

C. A. HERRICK, *Secretary*
133 Geary St., San Francisco, Cal.

COLORADO STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Colorado State Board of Dental Examiners will be in Denver, Colorado, June 6. For further information, address

WILLIAM H. FLINT, *Secretary*
Littleton, Colo.

ALABAMA BOARD OF DENTAL EXAMINERS

The Board of Dental Examiners of Alabama will meet Monday, June 19, 1922, at 9:00 A. M. at the Birmingham Dental College, Avenue F and 20th St., Birmingham, Alabama for the purpose of examining applicants who hold diplomas from reputable dental colleges, for certificate of qualification to practice dentistry in Alabama.

All applications accompanied by the examination fee, must be filed with the Secretary-Treasurer at least one week previous to the examination. For further information, application blanks, etc., address

H. CLAY HASSELL, *Secretary-Treasurer*
616 22d Ave., Tuscaloosa, Ala.

IOWA STATE DENTAL BOARD

The Iowa State Board of Dental Examiners will meet for the purpose of examining candidates for a license to practice in Iowa, at Iowa City, College of Dentistry, beginning at 9:00 A. M., Monday, May 29. An examination for dental hygienists will also be given.

For further information and application blanks, address

C. B. MILLER, *Secretary*
726 Fleming Bldg., Des Moines, Iowa.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

The Florida State Board of Dental Examiners will hold the annual meeting, June 7, 8, 9, 10, in Jacksonville, for the purpose of examining all qualified applicants.

R. P. TAYLOR, *Secretary*
Jacksonville, Fla.

MARYLAND BOARD OF DENTAL EXAMINERS

The Maryland Board of Dental Examiners will meet for examination of candidates for certificates on June 7, 8, 9, at the dental department at the University at Maryland, Baltimore, at 9:00 A. M.

For application blanks and further information, apply to

F. F. DREW, *Secretary*
701 N. Howard St., Baltimore, Md.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the North Carolina State Board of Dental Examiners will be held at Wrightsville Beach, Wilmington, N. C., beginning promptly at nine o'clock on Thursday morning, June 8.

For further information and application blank, address

F. L. HUNT, *Secretary*
Asheville, N. C.

PENNSYLVANIA STATE BOARD OF DENTAL EXAMINERS

The Pennsylvania Board of Dental Examiners will hold an examination for applicants for a license to practice dentistry in Pittsburgh and Philadelphia on Wednesday, Thursday, Friday and Saturday, June 21, 22, 23, and 24.

The theoretical examinations will begin on Wednesday, June 21, and will be held in the Musical Fund Hall, 808 Locust Street, Philadelphia, and the College of Pharmacy Building, Pride and Bluff Streets, Pittsburgh.

The practical examinations will be held on Saturday, June 24, in the Evans Institute, Fortieth and Spruce Streets, Philadelphia, and the University of Pittsburgh, Pittsburgh. The operative work will start at 8:30 A. M. and the prosthetic work at 1:30 P. M.

A partial examination will be held for students who have finished the work of the second year in college, on Wednesday and Thursday, June 21 and 22, in the same places. No others except second-year students are eligible for the partial examination.

An examination will also be held for dental hygienists on Thursday, Friday and Saturday, June 22, 23 and 24. Only hygienists who have four years' high-school preliminaries are eligible for this examination.

Application papers may be secured from the Department of Public Instruction, Harrisburg. Any further information may be secured from

ALEXANDER H. REYNOLDS, *Secretary*
4630 Chester Ave., Philadelphia, Pa.

VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The regular annual meeting of the Virginia State Board of Dental Examiners for the examination of applicants will be held in the city of Richmond, June 13, at 9:00 A. M.

For further particulars apply to

J. P. STIFF, *Secretary*
Fredericksburg, Va.

WEST VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The West Virginia Board of Dental Examiners will hold license examination for dentists and dental hygienists at Wheeling, June 27. For full information, application blanks, etc., address

R. MASON HITE, *Secretary*
Mannington, W. Va.

THE CONNECTICUT DENTAL COMMISSION

The Connecticut Dental Commission will meet at Hartford, Connecticut, on June 22, 23, and 24, to examine applicants for license to practice dentistry and dental hygiene and to transact any other business proper to come before them. For further information apply to

ROBERT H. W. STRANG, *Recorder*
886 Main St., Bridgeport, Conn.

MICHIGAN DENTAL EXAMINATIONS

The next examination in dentistry in this state will be held in the city of Ann Arbor, Dental College, the week of June 5 to 11, inclusive. Application blanks, and all information relative to this examination may be had by applying to

E. O. GILLESPIE,
745 David Whitney Bldg., Detroit, Mich.

NEW JERSEY BOARD OF REGISTRATION

The State Board of Registration and Examination in Dentistry for New Jersey will hold its regular examination at Trenton, New Jersey, June 26 to 30. License fee, $25.00; re-examination fee, $10.00.

Practical tests required: Insertion of an approximal gold filling with the approximating tooth in position, compound approximal amalgam filling, and a silicate filling; candidate must furnish his own patient. Taking of impressions, bite, selection of teeth, articulation, trial plate; candidate must furnish his own patient. Practical examination in mouth diagnosis.

Attention is directed to the following quotation from the dental law of New Jersey: "Applicant shall present to said board a certificate from the Commission of Education of this state, showing that before entering a dental college he or she had obtained an academic education consisting of a four-year course of study in an approved high school, or the equivalent thereof." In accordance with this law the secretary will issue application blanks only upon presentation of the required certificate from the Commissioner of Education, State House, Trenton, New Jersey.

Applications must be filed, complete, ten days before the date of the examinations. Address all communications for further particulars to

JOHN C. FORSYTH, *Secretary*
429 E. State St., Trenton, N. J.

NATIONAL ALUMNI ASSOCIATION OF THE BALTIMORE COLLEGE OF DENTAL SURGERY

As the time for the reunion approaches the plans become more definite. An excellent program is anticipated and the following have been selected as speakers: Emory C. Thompson of Pennsylvania, Paul R. Stillman and James Kendall Burgess of New York, Harvey J. Burkhart of Rochester and B. Lucien Brun and B. Holly Smith of Baltimore.

It has been decided to make the unveiling of the Chapin A. Harris memorial an issue of the reunion and on June 1, Harvey J. Burkhart, on behalf of the dental profession, will present the monument to the city of Baltimore and deliver the presentation address. Mayor Broening of Baltimore will receive the monument on behalf of the city.

As to hotel accommodations, headquarters will be at the Emerson Hotel as previously announced, and they have agreed to the following rates: room and bath, equipped with twin beds, $4.00 per person; room and bath, equipped with double bed, $5.00 one person, $6.00 two persons. Louis Rossmann, 829 Park Avenue, Baltimore, is chairman in charge of the hotel reservations and will be very glad to have rooms reserved for anyone desiring him to do so.

NORVAL H. MCDONALD, *Secretary*
904 N. Charles St., Baltimore, Md.

AMERICAN DENTAL LIBRARY AND MUSEUM ASSOCIATION

The next annual meeting of the American Dental Library and Museum Association will be held Monday, July 17, at the Hotel Ambassador, Los Angeles, California.

The membership consists now of over forty dental libraries and it is hoped that all dental institutions owning a library will join.

In order for the Association to accomplish its purpose it will be necessary and an advantage to all dental libraries to be members. Any institution or individual interested in dental literature or history is eligible for membership.

B. W. WEINBERGER, *Secretary*
40 E. 41st St., New York, N. Y.

NATIONAL DENTAL SORORITY

The National Dental Sorority was organized at Milwaukee, Wisconsin, August 18, 1921.

This Sorority is making splendid progress. More than three hundred have received invitations to join; one hundred have sent their dues and expressed their intention of being present at the National meeting in Los Angeles in July. The president, M. Evangeline Jordon, 1125 Marsh-Strong Building, Los Angeles, announces that the Sorority will have its headquarters at the Ambassador Hotel.

For further information communicate with

MAE FONTAINE, *Secretary*
406 Consolidaed Realty Building,
Los Angeles, Cal.

THE PACIFIC COAST SOCIETY OF ORTHODONTISTS

A cordial invitation is extended to all interested in orthodontia to attend the next annual meeting of the Pacific Coast Society of Orthodontists, which will be held in Los Angeles, California, July 13, 14, 15, 1922. Those who contemplate being in attendance are requested to make known their intention to the Secretary as soon as possible.

CARL O. ENGSTROM, *Secretary-Treasurer*
Box 1070, Sacramento, Cal.

PSI OMEGA FRATERNITY

The annual New York alumni banquet will be held Saturday evening, April 22, in the Hotel Astor at 7:00 P. M.

The banquet this year will be in celebration of our thirtieth anniversary and a cordial invitation is extended to all visiting members. Kindly secure reservations in advance from John L. Peters, treasurer, 133 W. 72d St., New York City.

MICHAEL J. MCCAUGHLEY, *Chairman*
260 Garfield Pl., Brooklyn, N. Y.

XI PSI PHI FRATERNITY

The annual meeting of the National Alumni Chapter of the Xi Psi Phi Fraternity will be held at Hayward Hotel, Los Angeles, California, Monday afternoon, July 17; banquet, Monday evening at California Club. Registration headquarters the fifth floor of the Ambassador Hotel.

J. EMMETT NORTHCUTT, *Secretary-Treasurer*
St. John and Elmwood Ave., Kansas City, Mo.

DENTAL HYGIENIST ASSOCIATION OF THE STATE OF NEW YORK

The second annual meeting of the Dental Hygienists Association of the State of New York, will be held at Rochester Dental Dispensary, Rochester, New York, May 12 and 13.

Friday morning, May 12, at nine-thirty a meeting of the Executive Board will be held. Following that, a luncheon will be served.

At two o'clock there will be a business session for members only, after which short talks will be given by Miss Mabel French, D. H., of Philadelphia; Miss Verna Thornhill, D. H., instructor of oral hygiene in Public Health Service; and Miss Mary B. Knight, D. H., in charge of Child Welfare Work in Delaware.

Friday evening at eight o'clock the Dental Society has invited all the hygienists to attend a lecture on "Modern Conception of Infection," by Weston A. Price of Cleveland.

Saturday morning, at nine o'clock, clinics will be held at Convention Hall in conjunction with the clinics of the dental society. Clinicians from the Columbia School of Dental Hygiene and the Rochester School of Dental Hygiene will demonstrate. There will be nine chair clinics, several of which will show hospital work on bed patients, Red Cross, state and institutional work, general office prophylaxis, child and orthodontia hygiene.

At three o'clock at the Rochester Dental Dispensary, a reception and tea followed by dancing will be given by the alumnae of the Rochester School of Dental Hygiene and the class of 1922.

Saturday evening at eight o'clock, a public meeting will be given in the main clinic room of the Dispensary. Speakers will be announced later.

MAIDA M. FOERY,
Chairman Publicity Committee.

THE AMERICAN SOCIETY OF DENTAL RADIOGRAPHERS

The annual meeting of the American Society of Dental Radiographers will be held at the Ambassador Hotel, Los Angeles, California, Wednesday and Thursday, July 19 and 20. The Program Committee has arranged for an interesting and scientific meeting. All those extremely interested in dental radiography are cordially invited to attend.

MARTIN DEWEY, *Secretary-Treasurer*
501 Fifth Ave., New York, N. Y.

ORGANIZATION OF THE NEVADA STATE DENTAL ASSOCIATION

On January 10, a meeting of the Nevada dentists was held in Reno, at which meeting the Nevada State Dental Association was organized. Dr. John Millikin of San Francisco, who is a trustee of the National Dental Association and president-elect of the California Dental Association was present and the organization was formed under his leadership.

The following officers were elected: G. H. Marvin, president; Bruce Saulter, vice-president; Thomas H. Suffal, secretary; Fred J. Rulison, treasurer; George A. Carr, editor. G. H. Marvin was elected delegate to the National Dental Association and Bruce Saulter as alternate.

TRANSPORTATION ARRANGEMENTS FOR LOS ANGELES MEETING

Summer tourist tickets available for this convention will be on sale daily, May 15 to September 30, 1922, inclusive, permitting stop-over at any point en route within final return limit of October 31.

On account of the reduction in fares for the coming season over those in effect last year the railroads are delayed in the announcement and the fares cannot as yet be quoted, except from a few principal points in western territory.

The following fares to Los Angeles and return have been definitely decided.

From	Direct Routes Going and Returning	One Way via Portland or Seattle
Chicago	$86.00	$104.00
Kansas City	72.00	90.00
Omaha	72.00	90.00
St. Louis	81.50	99.50
Memphis	85.15	106.28
New Orleans	85.15	114.08
St. Paul	87.50	97.75
Minneapolis	87.50	97.75

Correspondingly low fares will be on sale from all points in the United States and a more extensive tariff will be published as soon as available.

For the accommodation of those attending the meeting, the Transportation Committee has completed arrangements for the operation of two official special trains from Chicago, which will afford a choice of routes with a variety of entertainment and scenic points of interest.

You will note from the schedules that both trains will leave Chicago the same evening, arriving the same hour at Colorado Springs, where a most enjoyable day will be spent by the entire party.

For those desiring to travel via the Grand Canyon the following schedule has been prepared.

SPECIAL TRAIN SCHEDULE VIA ATCHISON, TOPEKA AND SANTA FE RAILWAY (SANTA FE)

Lv. Chicago	10:30 P. M. Sunday, July 9.
Ar. Kansas City	10:40 A. M. Monday, July, 10.
Lv. Kansas City	10:45 A. M. Monday, July 10.
Ar. Colorado Springs	7:00 A. M. Tuesday, July 11.
Lv. Colorado Springs	5:50 P. M. Tuesday, July 11.
Ar. Santa Fe, N. M.	9:15 A. M. Wednesday, July 12.
Lv. Santa Fe, N. M.	12:15 Noon Wednesday, July 12.
Ar. Albuquerque	3:15 P. M. Wednesday, July 12.
Lv. Albuquerque	4:35 P. M. Wednesday, July 12.
Ar. Isleta	5:00 P. M. Wednesday, July 12.
Lv. Isleta	6:00 P. M. Wednesday, July 12.
Ar. Grand Canyon	7:00 A. M. Thursday, July 13.
Lv. Grand Canyon	7:25 P. M. Thursday, July 13.
Ar. Los Angeles	2:35 P. M. Friday, July 14.

The sidetrip from Lamy to Santa Fe, N. M., and return is contingent upon a sufficient number for special train service. The balance of intinerary can be carried out for the actual number in the party.

An illustrated circular describing this trip has been prepared and may be had by addressing J. R. Moriarity, Division Passenger Agent, A. T. & S. Fe Ry., 179 W. Jackson Boulevard, Chicago, Ill.

SPECIAL TRAIN VIA THE CHICAGO AND NORTH WESTERN RAILWAY

The Special Train via Chicago & North Western-Union Pacific-Denver & Rio Grande to Colorado Springs, thence thru the Colorado Rockies and Salt Lake City will accommodate those who desire to travel via the Colorado Rockies and Salt Lake City direct to Los Angeles, or from Salt Lake City via San Francisco to Los Angeles.

(Sleepers ready 9:00 P. M. Sunday, July 9).

Lv. Chicago 12:15 A. M. (C. T.) Sunday, July 9, C. & N. W.
Ar. Omaha 1:45 P. M. (C. T.) Monday, July 10, C. &. N. W.
Lv. Omaha 2:00 P. M. (C. T.) Monday July 10, Union Pacific
Ar. Denver 4:00 A. M. (M. T.) Tuesday, July 11, Union Pacific
Lv. Denver 4:30 A. M. (M. T.) Tuesday, July 11, D. & R. G.
Ar. Colorado Srpings 7:00 A. M. (M. T.) Tuesday, July 11, D. & R. G.

(Day and evening to be spent in and around Colorado Springs, visit to Pikes Peak, Crystal Park Auto Trip, Cripple Creek, Manitou, Garden of the Gods, Cave of the Winds, etc.)

(Sleepers ready for occupancy 9:30 P. M.)

Lv. Colorado Springs 4:00 A. M. (M. T.) Wednesday, July 12, D. & R. G.
Ar. Royal Gorge 7:00 A. M. (M. T.) Wednesday July 12, D. & R. G.
Ar. Tennessee Pass 12:00 N'N (M. T.) Wednesday, July 12, D. & R. G.
Ar. Glenwood Springs 3:15 P. M. (M. T.) Wednesday, July 12, D. & R. G.
Ar. Salt Lake City 7:00 A. M. (M. T.) Thursday, July 13, D. & R. G.

(6 hours and 50 minutes stop-over at Salt Lake City)

Lv. Salt Lake City 2:50 P. M. (P. T.) Thursday, July 13, Union Pacific
Ar. Los Angeles 2:40 P. M. (P. T.) Friday, July 14, Union Pacific

Those who wish to travel via San Francisco will have four hours and forty minutes in Salt Lake City, leaving via Western Pacific Railroad on the following schedule for San Francisco:

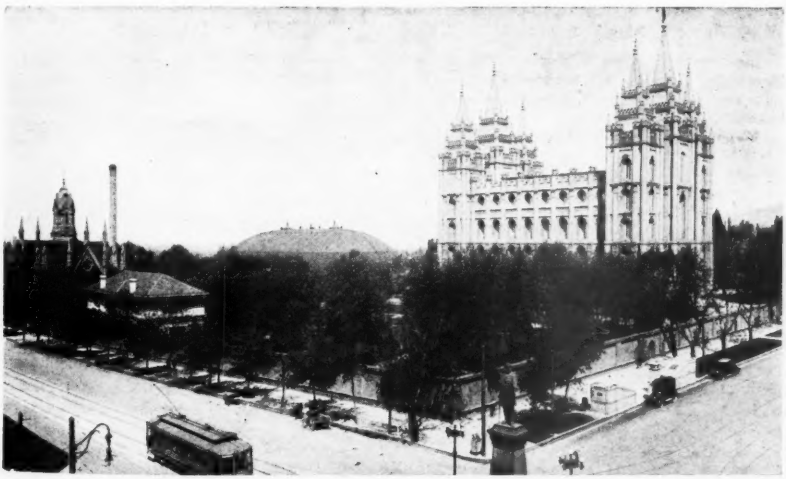
Lv. Salt Lake City 12:40 P. M. (P. T.) Thursday, July 13, Western Pacific
Ar. Feather River Canyon 7:00 A. M. (P. T.) Friday, July 14, Western Pacific
Ar. San Francisco 6:00 P. M. (P. T.) Friday, July 14, Western Pacific

If rail line is desired between San Francisco and Los Angeles, the following train may be used:

Lv. San Francisco 8:00 P. M. (P. T.) Friday, July 14, Southern Pacific
Ar. Los Angeles 9:30 A. M. (P. T.) Saturday, July 15, Southern Pacific

Advance information, descriptive literature and sleeping-car reservations may be secured by addressing H. G. Van Winkle, General Agent, Chicago and North Western Railway, 148 South Clark Street, Chicago, Ill.

TRANSPORTATION COMMITTEE, D. C. BACON, *Chairman*.



TEMPLE SQUARE, SALT LAKE CITY

DENTAL CORPS ORDERS FROM WAR DEPARTMENT

Navy

Lieutenant F. A. Batkin, R. S., San Francisco, Calif.; resignation accepted—*Army and Navy Register*, February 25, 1922.

Lieutenant E. G. Hoylman, receiving barracks, Hampton Roads, Va.; to naval air station, San Diego, Calif.

Lieutenant L. C. Frost, to naval hospital, Canacao, P. I.—*Army and Navy Register*, March 4, 1922.

Lieutenant J. J. Hass, Columbia; to R. S., Philadelphia, Pa.

Lieutenant J. A. Kelly, Chaumont; to naval training station, Hampton Roads, Va. —*Army and Navy Register*, March 18, 1922.

The following promotions in the Navy are announced:

To be dental surgeon, with the rank of lieutenant commander: Frank L. Morey.

To be dental surgeons: Anson F. McCreary and Hugh T. Meyers.

To be passed assistant dental surgeons, with the rank of lieutenant: James C. Lough and Armin T. Fellows.

Army

Captain W. D. Love, from duty at Fort Omaha, Neb., to Fort Snelling, Minn., for duty.—*Army and Navy Register*, February 25, 1922.

Major. H. L. Thompson, report to retiring board at Fitzsimons General Hospital, Denver, Colo., for examination.—*Army and Navy Register*, March 4, 1922.

Lieutenant Colonel Albert R. White from Brooklyn, N. Y., to Walter Reed General Hospital, D. C., for observation and treatment.

Major Arthur J. Skillman from duties at station hospital, Fort Sam Houston, Tex., to Brooklyn, N. Y., general intermediate depot, for duty.

Captain Joseph H. Jones from duty at Fort Huachuca, Ariz., to San Francisco and about May 15 to Philippine Department for duty.

Captain William F. Wieck from duties in China, effective upon completion of present tour of foreign service, and upon arrival in United States will report by telegraph to commanding general 8th corps area for assignment to duty and station.—*Army and Navy Register*, March 11, 1922.

Captain Daniel J. Crowley from Fort Ethan Allen, Vt., to Walter Reed General Hospital, D. C., for observation and treatment.

Captain Harold S. Whitney report to retiring board at Washington for examination. —*Army and Navy Register*, March 18, 1922.

The following promotion in the Army is announced: William J. Adlington to be captain.

List of applicants who have accepted appointments in Dental Reserve Corps: First Lieutenant C. L. Perrizo, Jasper, Minn.; First Lieutenant W. P. Gasser, Arcadia, Wis.; Major O. F. Freitag, St. Louis, Mo.; Major R. C. Kiebler, Duncan, Okla.

Navy Dental Corps

Rear Admiral Stitt stated that the present authorized allowance of officers for the dental corps is 189, and that there are 159 officers in the corps, with two resignations pending. With a personnel of 75,000 there would be but 116 officers.

It is asserted that the formerly established ratio of one dentist to one thousand men is not enough, and Admiral Stitt expressed his opinion that the ratio should not be greater than one to seven hundred fifty. He also called attention to the great desire to extend dental facilities to families of officers and enlisted men as they now receive medical attention, and if this is done the ratio will not provide enough officers of that corps to properly perform the work. The veterans' bureau quota is one dentist to every 250 men.

Representative Hicks wanted to know why the present ratio is greater than it has been in the past, and was informed that much more is demanded of the dental officers than ever before due to the advance of dental surgery.

The hearing adjourned after a long, aimless discussion of the relative merits of establishments at East Camp and Newport, and why they had not been made use of by the Army, Navy or veterans' bureau instead of constructing additional hospitals in the same localities.

Rear Admiral Gregory stated he would explain the matter to the committee's satisfaction when he appeared for the bureau of yards and docks.

nd Navy

om Fort
General
nd treat-

t to re-
mination,
18, 1922.

Army is
be cap-

pted ap-
s: First
Minn.;
Arcadia,
is, Mo.;

e present
the den-
are 159
ignations
00 there

tablished
men is
essed his
e greater
He also
o extend
cers and
dical at-
atio will
corps to
veterans'
very 250

now why
has been
at much
ers than
f dental

ng, aim-
s of es-
Newport,
use of
reau in-
pitals in

ould ex-
satisfac-
ureau of